Draft Final

Five-Year Review Report

Naval Station Norfolk

Norfolk, Virginia

Prepared for

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Executive Summary

CH2M HILL conducted this Five-Year Review Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Review for Naval Station Norfolk (NSN) in Norfolk, Virginia, in accordance with the U. S. Environmental Protection Agencies (USEPA) Five-Year Review Guidance (USEPA, June 2001). The document addresses remedies and remedial actions that resulted in hazardous substances, pollutants, or contaminants remaining at sites above levels that allow for unlimited use and unrestricted exposure; and for which there is a Record of Decision (ROD) or Decision Document (DD) in place. The six sites incorporated in this review include Site 1—Camp Allen Landfill (CALF), Site 2—NM Slag Pile, Site 3—Q Area Drum Storage Yard (QADSY), Site 6—CD Landfill, Site 20—Building LP-20, and Site 22—Camp Allen Salvage Yard (CASY). Though Site 22 is not required to have a Five-Year Review performed until August 2003, the Navy has decided to include this site in the Five-Year Review at this time in an effort to perform an efficient and systematic installation-wide review of all sites at NSN.

The Five-Year Review's objective is to evaluate current remedies at these sites and determine whether the remedies are protective of human health and the environment in accordance with the requirements set forth in the ROD or DD. The principal method used to evaluate the protectiveness of the remedies was a review of various reports and documents pertaining to site activities, analytical data, and findings. The methods, findings, and conclusions from the document reviews are presented in this Five-Year Review report. In addition, the Five-Year Review report identifies any issues that may prevent a particular remedy from functioning as designed or appropriate and may endanger the protection of human health and the environment. The overall evaluation of the effectiveness of each remedy is presented as a protectiveness statement developed for each site. The protectiveness statements are provided below.

Site 1—Camp Allen Landfill

The current operation of the groundwater extraction and treatment at Camp Allen Landfill was found to be protective of human health and the environment. The extraction system has prevented migration of the contaminant plume to residential areas west and southeast of the site. However, as part of an ongoing optimization effort, the treatment system will be expanded with the addition of new extraction wells to contain the plume north of the site and southeast of the elementary school.

Site 2—NM Area Slag Pile

The remedy for Site 2—NM Slag Pile is protective of human health and the environment under the current industrial land use.

Site 3—Q Area Drum Storage Yard

The current air sparge/soil vapor extraction (AS/SVE) system at the QADSY was found to be protective of human health and the environment. The AS system in AOC 2 is operating and VOC mass continues to be removed from the groundwater at a significant rate. The remediation in AOC 1 has achieved the cleanup goals in those monitoring wells within the radius of influence of the AS system. However, the monitoring wells downgradient of the system have demonstrated increases in the concentrations of VOC breakdown product-vinyl chloride. As part of an ongoing optimization effort, an enhancement of the remediation system is currently being considered in the localized area of increased vinyl chloride concentrations. The system's enhancement is targeted for reduction in the vinyl chloride concentrations to achieve the acceptable levels such that the closeout strategy developed by the NSN Tier I Partnering Team can be achieved.

Site 6—CD Landfill

The current landfill cap and institutional controls at CD Landfill were found to be protective of human health and the environment. The PWC inspects the CD Landfill quarterly PWC and an outside contractor does so annually. The 2002 annual inspection identified minor maintenance issues that did not impact the integrity of the remedy or institutional controls at the CD Landfill. The minor issues include:

- Small damage to the top of fence that does not impact security
- Erosion of a portion of sideslope in a drainage channel that does not affect the cover's integrity as it is on the opposite side of the landfill
- Erosion near the downstream ends of the culverts that appears to be stabilizing with vegetation
- Potential sedimentation of drainage net outlet pipes; however, this is not an issue as there are other visible outlets from drainage net.

It is recommended that the maintenance issues continue to be monitored during the inspections to make certain they will not have an impact on the remedy.

Site 20—Building LP-20

The current AS/SVE system at Building LP-20 was found to be protective of human health and the environment. The system has been effective in reducing the VOC concentrations within the contaminant plume. Additional evaluation of the effectiveness of the system and potential for optimization will be conducted.

Site 22—Camp Allen Salvage Yard

Once completed, the remedy for Site 22—Camp Allen Salvage Yard is anticipated to be protective of human health and the environment under the projected recreational land use.

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Acronyms and Abbreviations

AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
AS/SVE	air sparge/soil vapor extraction
AST	aboveground storage tank
CALF	Camp Allen Landfill
CASY	Camp Allen Salvage Yard
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-term Environmental Action Navy
COC	chemicals of concern
DD	Decision Document
DPVE	Dual Phase Vapor Extraction
ERM	Effects Range-Median
HM	hazardous material
IAS	Initial Assessment Study
IRP	Installation Restoration Program
LANTDIV	the Atlantic Division
LTM	Long-Term Monitoring (LTM
msl	mean sea level
NAS	Naval Air Station
NCP	National Contingency Plan
NPL	National Priorities List
NSN	Naval Station Norfolk
OU	Operable Unit
PAH	polynuclear aromatic hydrocarbon
PA/SI	Preliminary Assessment/Site Investigation
PCB	Polychlorinated Biphenyls
PP	petroleum product
PRAP	Proposed Remedial Action Plan
PWC	Navy Public Works Center
QADSY	Q Area Drum Storage Yard
RBC	Risk-Based Concentration
RI/FS	Remedial Investigation/Feasibility Study
RI/RA	Remedial Investigation/Risk Assessment
ROD	Record of Decision

SI	Site Investigation
SVOC	semivolatile organic compound
TPH	total petroleum hydrocarbon
USEPA	U. S. Environmental Protection Agencies
VDOT	Virginia Department of Transportation
VOC	volatile organic compound

1 Introduction

CH2M HILL conducted a Five-Year Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Review under the Atlantic Division (LANTDIV) Comprehensive Long-term Environmental Action Navy (CLEAN) II Program, Contract No. N62470-95-D-6007, Contract Task Order 0251. The Five-Year Review was prepared for Naval Station Norfolk (NSN) in Norfolk, Virginia, in accordance with the Comprehensive Review Guidance (USEPA, June 2001). This document addresses remedies and remedial actions regarding hazardous substances, pollutants, or contaminants remaining at sites above levels that allow for unlimited use and unrestricted exposure; and for which there is a Record of Decision (ROD) or Decision Documents (DD) in place. This report includes a review of the remedial actions at six sites at NSN and was conducted from July 1 to September 30, 2002. These six sites include: Site 1—Camp Allen Landfill (CALF), Site 2—NM Slag Pile, Site 3—Q Area Drum Storage Yard (QADSY), Site 6—CD Landfill, Site 20—Building LP-20, and Site 22—Camp Allen Salvage Yard (CASY). Though Site 22 is not required to have a Five-Year review performed until August 2003, the Navy has decided to include this site at this time in an effort to perform an installation-wide review of all sites at NSN in an efficient and systematic manner.

The objective of this Five-Year Review is to evaluate current remedies at these six sites and determine whether the remedies are protective of human health and the environment in accordance with the requirements outlined in the Records of Decision (RODs) or Decision Documents (DDs). The principal method used to evaluate the protectiveness of the remedies was a thorough review of reports, analytical data, and documents pertaining to site activities and findings. This report presents the methods, findings, and conclusions from the document reviews. In addition, the Five-Year Review identifies any issues that may prevent a particular remedy from functioning as designed or as appropriate, which could endanger the protection of human health and the environment.

This Five-Year Review was prepared pursuant to CERCLA 121 and the National Contingency Plan (NCP) requirements. A Five-Year Review is required 5 years from the initiation of the first remedial action that leaves hazardous substances, pollutants, or contaminants remaining at sites above levels that allow for unlimited use and unrestricted exposure. If a site contains multiple remedies, all are subject to a Five-Year Review when at least one remedy is triggered. NSN has elected to follow Navy recommendations of conducting an installation-wide Five-Year Review that includes all sites with remedies in place based on the remedy initiation trigger date for the first site.

CH2M HILL prepared this Five-Year Review pursuant to CERCLA 121 and the NCP. CERCLA 121 states:

> *If the president selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgement of the President that action is appropriate at*

> *such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

CH2M HILL interpreted this requirement further in the NCP; 40 CFR 300.430 (f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

This is the first Five-Year Review for NSN. The triggering action of this statutory review is the non-time critical removal action at the CALF in May 1994. The Five-Year Review is required because hazardous contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

2 Background

In support of the Five-Year Review, the presentation of background information for NSN is necessary to identify the potential threats posed to the public and the environment at the time of the ROD or DD for each site. This allows for the remedy performance to be compared with the site conditions that the remedies were intended to address. Even though the ROD for Site 22—CASY is currently under review by the Navy and the USEPA, the Navy has decided to include this site in this Five-Year Review. Information presented in this section includes a discussion on the facility description, physical characteristics of the facility, listing of chronological events, and site-specific background information.

2.1 Facility Description

NSN is the world's largest naval base, encompassing 4,631 acres in the northwest portion of the City of Norfolk, Virginia. A map of NSN and the relative location of the sites evaluated in this report are shown in Figure 2-1. NSN includes approximately 4,000 buildings, 20 piers, and an airfield. The western portion of NSN is a developed waterfront area containing the piers and facilities for loading, unloading, and servicing naval vessels. Land use in the surrounding area is commercial, industrial, and residential. The waterfront area south of the NSN provides shipping facilities and a network of rail lines for several large industries.

NSN began operations in 1917, when the U.S. Navy acquired 474 acres of land to develop a naval base to support World War I activities. Bulkheads were built along the coast to extend available land and after extensive dredge and fill operations, 792 acres were under Navy control.

An additional 143 acres were acquired in 1918 and officially commissioned for the Naval Air Station (NAS). From 1936 through 1940, improvements to the piers and expansion of supply/material handling facilities were also completed.

During World War II, major construction projects were completed, including a power plant, numerous runways and hangars, a tank farm, and several barracks/housing complexes. During this time, the area of NSN expanded to more than 2,100 acres. After World War II, NSN continued to acquire land through various types of land transfers and dredge-and-fill operations conducted in areas of Mason Creek, the Bousch Creek Basins, and Willoughby Bay.

NSN has expanded to become the world's largest naval installation, with 105 ships home-ported in Norfolk. The Base currently has 20 piers handling approximately 3,100 ship movements annually. NSN operates in various capacities to provide support to vessels, aircraft, and other activities. NSN houses many tenants, each performing different operations involving the servicing and maintenance of vessels and aircraft.

Ship service and maintenance facilities include utilities hook-up, on-board maintenance, and coordination of ship movements in the harbor. Additional functions include loading, unloading, and handling of fuels and oils used aboard the vessels. Ship and aircraft repair

operations consist of paint stripping, patching, parts cleaning, repainting, engine overhauls, sandblasting, and metal-plating processes.

NSN's mission is to provide fleet support and readiness for the U.S. Atlantic Fleet.

A number of other military installations are located within a 25-mile radius of NSN—Fort Monroe and Langley Air Force Base to the north, Little Creek Naval Amphibious Base and Fort Story to the east, Naval Air Station Oceana to the southeast, Norfolk Naval Shipyard and St. Juliens Creek Annex to the south, and Naval Supply Center-Craney Island Fuel Terminal to the southwest (CH2M HILL, October 1997).

2.2 Physical Characteristics

The major physiographic features of NSN and surrounding area are described in the following subsections.

2.2.1 Climate

The Hampton Roads Area has a maritime climate characterized by long temperate summers and mild winters. The average annual temperature is 60.7 °F. July is the warmest month, with temperatures averaging 78.7 °F, while January is the coolest, with temperatures averaging 43.1 °F. Precipitation averages 43 inches annually and is evenly distributed throughout the year. A slight increase in precipitation occurs from June to August due to the prevalence of convective thunderstorms. The average annual snowfall is 8.8 inches. Winds are generally in an easterly direction and of moderate speed, ranging from 6 to 8 knots (CH2M HILL, October 1997).

2.2.2 Topography

The topography of NSN is nearly level. Surface elevations at the base range from sea level to about 15 feet above mean sea level (msl) in the central portion of the base.

2.2.3 Soils

Soils at NSN generally consist of fine sands and silts with a thickness of 20 to 40 feet having low to moderate permeability. Relatively impermeable sediments composed of silt, clay, and sandy clay typically underlie this upper layer of soils. Together, these strata have a combined thickness of approximately 60 feet. The average permeability of soils in Norfolk County is less than 2.5 inches per hour.

The soils at NSN are a complicated distribution of naturally occurring material and dredge-and-fill material. The native soils are composed of unconsolidated fine sands and silts of low to moderate permeability and are generally underlain by relatively impermeable sediments consisting of silt, clay, and sandy clay. The fill material is primarily composed of heterogeneous sediments removed during dredging operations. The composition of the dredge-fill sediments varies from site to site, but it is generally composed of sand, silt, and gravel. Some concrete, stone, and miscellaneous debris were also used as fill material (CH2M HILL, October 1997).

2.2.4 Surface Water Resources

Four major surface water features surround the greater Norfolk area including the James and Elizabeth Rivers, Willoughby Bay, and Chesapeake Bay, all of which are tidal. Most surface water on the base flows either to Mason Creek or to the remnants of Bousch Creek. The northernmost channel of Mason Creek traverses the base and empties into Willoughby Bay via a subgrade aqueduct. The main channel of Bousch Creek was filled in and replaced by a network of drainage ditches during the base's development. These narrow drainage channels are interspersed throughout the central part of the base. Both Mason Creek and these drainage ditches are tidal throughout the base. Both creeks discharge to Willoughby Bay and ultimately, to the Chesapeake Bay. Some surface water from the base discharges directly into the Elizabeth River (CH2M HILL, October 1997).

2.2.5 Geology and Hydrogeology

NSN is located in the outer Atlantic Coastal Plain Physiographic Province, which is characterized by low elevations and gently sloping relief. The base is underlain by more than 2,000 feet of gently dipping sandy sediments. Table 2-1 illustrates the stratigraphic hydrogeologic units of southeastern Virginia.

The uppermost geologic unit is the Columbia Group, which is approximately 60 feet thick. The upper 20 to 40 feet consist of unconsolidated fine sands and silts. These sediments possess low to moderate permeabilities and comprise the unconfined Columbia aquifer. The lower 20 to 40 feet consist of relatively impermeable silt, clay, and sandy clay.

The Chesapeake Group underlies the Columbia Group. The uppermost unit in the Chesapeake Group is the Yorktown Formation. It is capped by the Yorktown confining unit, which separates the Columbia aquifer from the underlying Yorktown aquifer. The Yorktown formation is approximately 90 to 100 feet thick in the vicinity of NSN and composed of marine silt and clay and moderately consolidated coarse sand and gravel with abundant shell fragments. The Chesapeake Group is composed of several additional deeper aquifers and confining units.

Two significant shallow aquifer systems in the area are the Columbia aquifer located in the upper 20 to 40 feet of the Columbia Group, and the underlying Yorktown Aquifer. The Columbia aquifer includes the water-table aquifer, is reportedly thin, and consists of discontinuous heterogeneous sand and shell lenses. The water table depth is usually less than 8 feet. The Yorktown Aquifer is semi-confined beneath a clay layer in the upper Yorktown Formation. Water-bearing zones in the Yorktown Aquifer consist of fine to coarse sand, gravel, and shells (CH2M HILL, October 1997).

2.3 Site Chronology

Historical land use and practices at Naval Station Norfolk resulted in the contamination of the environment in some areas. The CALF, NM Slag Pile, QADSY, CD Landfill, Building LP-20, and CASY were identified as sites where remediation was required. The following timelines for these six sites present the significant events that have occurred prior to this review.

2.3.1 Site 1—Camp Allen Landfill

1940s-1974	Use of Area A to dispose of municipal, solid, and hazardous wastes.
1971	Use of Area B to dispose of wastes from a fire at CASY
1983	CALF identified as a potential source of contamination in the Initial Assessment Study (IAS)
1988	Installation Restoration Program Investigation Interim Report completed
May 1994	Non-time-critical soil removal action implemented in Area B
1994	Remedial Investigation/Feasibility Study (RI/FS) completed
1995	Proposed Remedial Action Plan (PRAP) completed and DD signed
April 1997	Naval Station Norfolk placed on the National Priorities List (NPL)
1997	Construction of the groundwater extraction and Dual Phase Vapor Extraction (DPVE) system
1998	Continuous operation of the groundwater extraction and DPVE system begun.
1999	Implementation of annual Long-Term Monitoring (LTM)

2.3.2 Site 2—NM Slag Pile

1950s-'60s	Disposal of slag, fly ash, and/or bottom ash at the site
1983	Slag Pile identified as a potential source of contamination in the IAS
April 1997	Naval Station Norfolk placed on the NPL
August 1998	RI completed
September 1998	FS completed
1999	PRAP completed
September 1999	Remedial Action Design completed
November 1999	Sediment removal action completed
February 2000	Placement of the soil and asphalt cover was completed
October 2000	Implementation of annual LTM
December 2000	ROD signed

2.3.3 Site 3—Q Area Drum Storage Yard

1950s-'80s	Area was used to store drums
1983	Area identified as a potential source of contamination in the IAS

1987	Soil removal action completed
1988	Interim RI completed
1996	RI/FS completed
1996	PRAP completed and Decision Document signed
April 1997	Naval Station Norfolk placed on the NPL
1997	Construction of the air sparge/soil vapor extraction system
August 1998	Remediation system began operation
February 1999	Implementation of the biannual LTM
September 1999	System operation was modified to a 2-week cycle of pulsing

2.3.4 Site 6—CD Landfill

1974-1979	Disposal of material in the unpermitted (eastern) section of the landfill
October 1979	Virginia Department of Health issued a permit for disposal of demolition debris and non-putrescible wastes at the site
1979-1987	Disposal of material in the permitted (western) section of the landfill
1983	CD Landfill identified as a potential source of contamination in the IAS
1991	Site Investigation (SI) completed
1993	Seabee Road was constructed over the site
1995	RI completed
July 1996	FS completed
October 1996	PRAP completed and Decision Document signed for site sediment-Operable Unit (OU) 1
April 1997	Naval Station Norfolk placed on the NPL
1997	Removal of contaminated sediments
1998	PRAP completed and ROD signed for site soil and groundwater (OU2)
December 1999	Construction of the landfill cap was completed
December 1999	Post-Closure Plan was completed
2000-2001	Quarterly groundwater and surface water monitoring conducted
March 2001	First Annual Post-Closure Monitoring Report completed
February 2002	Second Annual Post-Closure Monitoring Report completed
June 2002	Biannual LTM implemented

2.3.5 Site 20—Building LP-20

1940s-1990s	Numerous spills and releases documented in the area
Circa 1986	Product Recovery System #1 installed
Circa 1988-1990	Product Recovery System #2 installed
1991	Preliminary Assessment/Site Investigation (PA/SI) completed
December 1994	Product Recovery Systems shut down and dismantled
1995	RI/FS completed
1996	PRAP completed and Decision Document signed
April 1997	Naval Station Norfolk placed on the NPL
1997	Construction of the air sparge/soil vapor extraction system
April 1998	Remediation system began operation
November 1998	Annual LTM initiated

2.3.6 Site 22—Camp Allen Salvage Yard

1940s-1995	CASY used for salvage and processing of scrap materials
1982	CASY identified as a potential source of contamination in the IAS
1989	Polychlorinated Biphenyls (PCB) spill and preliminary cleanup
1993	PA/SI completed
1994	RI/FS for Areas A and B
1996	RI/FS Phase I and Phase II activities
1997	Initiation of the groundwater treatment system
April 1997	Naval Station Norfolk placed on the NPL
Sept 1997	EE/CA for PCB contaminated soil conducted
August 1998	Removal of PCB contaminated soil initiated
2000	FS prepared
January 2001	Draft PRAP submitted
2001	Continued removal of PCB and metals contaminated soils
2001	Proposal to Revise Preliminary Remediation Goals submitted
January 2002	EE/CA and Action Memorandum for metals contaminated soil submitted
March 2002	Revised Draft PRAP submitted

May 2002	Draft ROD submitted
July 2002	Installation of the soil cover completed

2.4 Description and Characterization of Sites

2.4.1 Site 1—Camp Allen Landfill

The Camp Allen Landfill site includes two distinct areas (Area A, the 45-acre landfill, and Area B, the 2-acre fire disposal area), as shown in Figure 2-2. The Area A landfill, which operated from the mid-1940s until approximately 1974, was used for the disposal of metal plating and parts-cleaning sludge, paint-stripping residue, various chlorinated organic solvents, expired chemicals, pesticides, asbestos, incinerator ash, fly and bottom ash from the Base power plant, and miscellaneous debris. Wastes from a fire at the Camp Allen Salvage Yard (Site 22), including drums containing various chemicals, were buried in trenches at Area B in 1971.

Currently, the Base brig facility and a heliport are located over a portion of the Area A landfill. Area B is not used at the present time. Areas A and B are soil-covered and vegetated to minimize surface erosion as they are both adjacent to tidal drainage ditches that convey stormwater runoff to Willoughby Bay.

The potential for site contamination from disposal practices was initially identified in the 1983 IAS (Environmental Science & Engineering, February 1983). Field investigations were conducted from 1983 to 1987 to characterize the nature and extent of contamination at the site. In March 1988 an Interim RI report (Malcolm Pirnie, May 1988) was completed. Additional groundwater and soil gas samples were collected from 1990 to 1991 and an RI/FS report (Baker Environmental, Inc., July 1994).

Contamination from prior disposal practices at the Camp Allen Landfill has affected surface and subsurface soil, sediment, surface water, and groundwater. The primary contaminants found at the site in all media are volatile organic compounds (VOCs). Two primary source areas of VOCs were identified north (Area A2) and south (Area A1) of the existing brig facility (Baker Environmental, Inc., July 1994). Areas of inorganic contamination of surface water and sediments in the surrounding drainage ditches and in the onsite pond also were detected. Groundwater contamination was found in both the water-table aquifer and the Yorktown Aquifer in Areas A and B. The presence of contamination in the deeper Yorktown Aquifer is thought to be due to the breach of a confining layer between the two aquifers beneath much of the Camp Allen Landfill area.

2.4.2 Site 2—NM Area Slag Pile

The NM Slag Pile (Figure 2-3) is a 1-acre disposal area for slag generated by an aluminum smelting operation during the 1950s and 60s. The slag is a residual cinder material formed from the fusion of a mineral such as limestone with impurities from the aluminum ore and ash from the blast-furnace fuel. In order to create a level surface upon which the slag could be deposited, fly ash and/or bottom ash (derived from coal burning operations elsewhere at NSN) was also used as fill material at the site. During the smelting operation, the slag pile area was defined by a lack of vegetation around the site near the slag pile. The site's surface

has since been regraded and vegetation was planted. Prior to remediation activities, the site's surface consisted of a gravel parking lot and open grassy field.

The potential for site contamination from metals—including chromium, cadmium, and zinc—was identified in the IAS (Environmental Science & Engineering, February 1983). Trace amounts of inorganics were detected in surface soil, surface water, and sediment samples taken during the Interim RI (Malcolm Pirnie, May 1988). However, the samples were taken after site regrading and placement of gravel surfacing. Since these activities disturbed the surface soil, these analytical results may not be representative of activities at the site.

The 1998 RI (CH2M HILL, August 1998) conducted at the site concluded that the disposal activities had impacted the site's groundwater and soil as well as sediment and surface water in the adjacent drainage channel. In correlation with the type of material disposed of at the site, the primary contaminants consist of metals—arsenic, antimony, cadmium, chromium, copper, iron, lead, nickel, silver, and zinc. However, significant concentrations of the organic chemicals 4-4'DDE and trichloroethene were also detected. Sediment and surface soil sampling was conducted in February 1998 to delineate the contamination limits for a sediment removal action.

2.4.3 Site 3—Q Area Drum Storage Yard

The Q Area Drum Storage Yard was a site that occupied approximately 5 acres in the northwest corner of NSN near the aircraft carrier piers (Figure 2-4). This area was created by dredging operations in the early 1950s. The QADSY was an open earthen yard used from the 1950s until the late '80s to store thousands of drums, most of which contained new petroleum products, various chlorinated organic solvents, paint thinners, and pesticides.

The potential for site contamination from drum storage activities was initially identified in the 1983 IAS (Environmental Science & Engineering, February 1983). The initial site visit noted dark stains on the soil and oil-saturated soil throughout the storage yard, indicative of past spills. The yard's northern portion, which was used to store leaking or damaged drums and hazardous materials, was particularly stained. The drums have since been removed, and the site was paved for its current use as a parking lot.

Field investigations were conducted from 1983 to 1986 to characterize the nature and extent of contamination at the site. The analytical results indicated that soil and groundwater were contaminated with metals and VOCs. In 1988 an Interim RI report (Malcolm Pirnie, May 1988) was completed. Additional soil, groundwater, sediment, and surface water samples were collected from 1990 to 1993.

The RI/FS (Environmental Science & Engineering, Inc., May 1996) conducted at the site revealed that the site was primarily contaminated with total petroleum hydrocarbons (TPH) and VOCs. In addition, some small-scale contamination of semivolatile organic compounds (SVOCs), metals, and pesticide was present. The shallow groundwater beneath the hazardous materials (HM) area and the northern portion of the petroleum products (PP) area was impacted the most. Some low VOC levels were also observed in the deep wells. This may be due to the lack of a confining layer between the two aquifers in this area. The general extent of the groundwater plume, which affects approximately 29 acres beneath the fleet parking area west of the site, has been defined with monitoring-well and direct-push

groundwater sampling. As a result of the delineation, the Q-Area has been subdivided into Area of Concern (AOC) 1 and AOC 2 to reflect two distinct plumes consisting of high concentrations of VOCs.

2.4.4 Site 6—CD Landfill

The CD Landfill site occupies approximately 22 acres and is just east of Hampton Boulevard and south of the Naval Exchange, as illustrated in Figure 2-5. The site incorporates two areas of landfilling operations; the easternmost (unpermitted) section and the western (permitted) section. The unpermitted portion operated from 1974 to 1979 and was used for demolition debris and inert solid waste, fly ash, and incinerator residue (CH2M HILL, February 2002).

In October 1979, the Naval Facilities Engineering Command received a permit from the Virginia Department of Health to use the landfill (western portion) for disposal of demolition debris and other non-putrescible wastes, excluding fly ash, incinerator residues, chemicals, and asbestos. Blasting grit used for sandblasting cadmium-plated aircraft parts was deposited at the landfill until 1981 when the blasting grit was tested and found to exceed the EP toxicity limit for cadmium. The grit was classified as a hazardous waste and onsite disposal of the material ceased. Landfilling operations continued in the site's western portion of the site. At the time the landfill permit was granted, a portion of the site's southeastern corner was removed and regraded to allow for runway expansion at the Naval Air Station (NAS). The runway expansion design specified that excess material was to be spread over the landfill and not removed from the site.

In 1993, Seabee Road was constructed over the site and opened to the public. Construction plans required only the addition of fill material; no cutting or grading into the existing landfill occurred. Most of the existing debris mounds situated in the north-central portion of the landfill were leveled and spread around the site to reduce the amount of standing water that accumulated after rain events.

The results of several investigations guided the scope of the RI, performed in 1993 and 1994. The RI was completed in three separate rounds of sampling. Soil, sediment, groundwater, and surface water samples were collected. As a result of the Remedial Investigation/Risk Assessment (RI/RA) Report, an FS was prepared in July 1996 to address contaminated media at the CD Landfill site. Potential risks associated with contaminants in the soil, sediments, groundwater, and surface water were identified and guided the development and evaluation of the media-specific remedial action alternatives. In addition to the FS, a separate geostatistical analysis was performed to evaluate and better define the areas of sediment contamination.

The RI (Baker Environmental, Inc., December 1995) conducted at the site concluded that the landfill activities had impacted the surface soil, subsurface soil, sediment, surface water, and shallow groundwater. The chemicals of concern (COCs) per media are summarized below:

- Soil—The most prevalent constituents are arsenic, beryllium, lead, and manganese. Additionally, constituents detected less frequently but at significant levels are antimony, cadmium, chromium, copper, nickel, vanadium, and zinc.
- Shallow groundwater—One organic compound (chlorobenzene) and several metals including arsenic, beryllium, chromium, lead, and manganese.

- Surface water—1,4-dichlorobenzene as well as lead and arsenic.
- Sediment—acetone, chlorobenzene, several polynuclear aromatic hydrocarbons (PAHs), pesticides, and PCBs.

In June 1997, the Partnering Team agreed to an additional sampling event to characterize the landfill material and determine closure requirements. A statistical sampling approach was developed to determine within a specified confidence interval whether the fill material would be classified as hazardous. All of the samples collected and analyzed during the June event were below the regulatory standards. Based on the statistical findings, the fill material at the CD Landfill is not considered a hazardous waste and it was agreed that the site would be closed under the Virginia Solid Waste Management Regulations for a construction demolition debris landfill.

2.4.5 Site 20—LP-20 Site

The LP-20 Site is one of many large buildings northwest of the NAS main runway, as shown in Figure 2-6. Currently, the building houses the Navy Public Works Center's (PWC's) Transportation Department. In the past, a portion of the building was used for aircraft engine overhaul and maintenance. Previous activities at the building included: painting, x-ray facilities, cleaning and blasting, and a metal-plating operation. Waste products generated from these activities were transferred to the industrial wastewater treatment plant via underground piping. In addition, a large fuel storage area, known as LP fuel farm, is also located south of the building. An underground pipeline extends from the Fuel Farm to buildings LP-78 and LP-176 located east of the site. Over the years (1940s to 1990s), Numerous spills or releases of wastewater and petroleum have been documented over the years (1940s to '90s). Significant releases were associated with damage to underground wastewater lines during construction activities, and leakage of the underground petroleum pipeline (Baker Environmental, Inc., December 1995).

Investigations at the site began in 1986 following a release of JP-5 fuel from the underground pipeline. Since 1986, approximately 10 separate investigations have been conducted to evaluate the extent of releases from underground fuel pipelines, the industrial wastewater line, and various USTs at the site. These investigations determined that significant amounts of free product as well as chlorinated solvents are present. A RI/FS (Baker Environmental, Inc., December 1995) summarizing the previous investigation data was completed in 1995.

The data generated during the RI (Baker Environmental, Inc., December 1995) indicate that VOCs are the primary contaminants detected in the area. Specifically, chlorinated solvents were detected in the vicinity of LP-20 and LP-26. In addition, petroleum products occur east of Building LP-22 and south of Building LP-179. High concentrations of vinyl chloride, 1,1-dichloroethene, 1,2-dichloroethene, 1,2-dichloroethane, trichloroethene, and benzene were observed in the shallow aquifer (Columbia). Furthermore, concentrations of vinyl chloride, 1,2-dichloroethene, and trichloroethene were also detected in the deep aquifer (Yorktown).

Because of the free product at the site, two product recovery systems were installed south and southeast of Building LP-22. Product Recovery System #1 was constructed in 1986, and Product Recovery System #2 was reportedly constructed some time between 1988 and 1990. Both systems operated four recovery wells that pumped groundwater and product into oil

water separators. The oil water separators discharged into Bousch Creek and the free product was collected in an aboveground storage tank (AST). According to the 1995 RI, neither system performed as anticipated and seldom operated at all due to mechanical problems. The systems were shut off in December 1994 and dismantled in 1995.

2.4.6 Site 22—Camp Allen Salvage Yard

The Camp Allen Salvage Yard (CASY), operated from the 1940s until 1995 salvaging and processing scrap materials generated at NSN. The CASY is located between Area A and Area B of the Camp Allen Landfill Site, as shown on Figure 2-7. CASY activities have included storage and management of waste oils, used chemicals, and scrap industrial/commercial equipment. Metal smelting, various recycling activities, and miscellaneous burning also occurred at the CASY. In addition, the facility was used to store acids, paint thinners, solvents, pesticides, and transformers. A PCB spill occurred at the CASY in 1989 when a transformer was damaged by a forklift. The PWC responded to the spill and conducted a preliminary cleanup at that time. When operations ceased in 1995, the buildings, incinerators, and rail lines were demolished.

A PA/SI (Baker Environmental, Inc., May 1994) was completed for the CASY in 1994 and the investigation results indicated that the surface and subsurface soil were contaminated with PCBs, pesticides, and metals. Additional data were generated during the RI (Baker Environmental, Inc., November 1999) and showed that the shallow and deep groundwater aquifers in the vicinity as well as sediment had detectable levels of PCBs and metals. However, the human health risk assessment identified no unacceptable risk from exposure to groundwater.

At present, the Virginia Department of Transportation (VDOT) has implemented a plan to extend the I-564 intermodal connector to the Norfolk International Terminals. The highway expansion will require that local utilities, Navy-owned ballfields, steamline, and a railroad be relocated impacting the northernmost section of the Salvage Yard. As a result, the Salvage Yard will be covered with a 1-foot vegetated cover. It is anticipated that ballfields will be constructed at the site to replace those demolished during the highway expansion.

TABLE 2-1.
Stratigraphic and Hydrogeologic Units of Southeast Virginia
(from Harsh and Laczniak, 1990)

Geologic Age		Group	Stratigraphic Formation	Hydrogeologic Unit
Period	**Epoch**			
Quaternary	Holocene	Columbia	Holocene Deposits	Columbia aquifer
	Pleistocene		Undifferentiated Deposits	
Tertiary	Pliocene		Bacons Castle Formation	Yorktown confining unit
		Chesapeake	Yorktown Formation	
				Yorktown-Eastover aquifer
	Miocene		Eastover Formation	
				St. Mary's confining unit
			St. Mary's Formation	
				St. Mary's Choptank aquifer
			Choptank Formation	
			Calvert Formation	Calvert confining unit
	Oligocene	Pamunkey	Old Church Formation	Chickahominy-Piney Point aquifer
	Eocene		Chickahominy Formation	
			Piney Point Formation	
			Nanjemoy Formation	Nanjemoy-Marlboro Clay confining unit
	Paleocene		Marlboro clay	
			Aquia Formation	Aquia aquifer
			Brightseat Formation	Brightseat confining unit
				Brightseat aquifer
Cretaceous	Late Cretaceous		Undifferentiated Sediments	Upper Potomac confining unit
	Early Cretaceous		Potomac Formation	Upper Potomac aquifer
				Middle Potomac confining unit
				Middle Potomac aquifer
				Lower Potomac confining unit
				Lower Potomac aquifer

3 Remedial Actions

3.1 Site 1—Camp Allen Landfill

3.1.1 Remedy Selection and Implementation

A DD (Baker Environmental, Inc., November 1993) was signed in November 1993 for removal of the contaminant source (buried debris and impacted soil) from Area B of the Camp Allen Landfill. A non-time-critical removal action was implemented in May 1994 and completed in January 1995. Approximately 11,500 tons of soil and debris were excavated and disposed offsite to remove the primary source areas of contamination in Area B. The extent of the removal action is shown in Figure 3-1.

A PRAP (Baker Environmental, Inc., March 1995) and second DD (Baker Environmental, Inc., July 1995) were issued in 1995 detailing localized treatment of groundwater and soil using vacuum extraction. In addition, the site's remediation required implementation of a groundwater extraction and treatment system in Areas A and B, and DPVE for "hot spots" identified in the Area A landfill. The remedial actions are summarized below:

Area A1

- Treatment of the soil and water table aquifer using a DPVE system in combination with institutional controls that control access to the site and incorporate land and groundwater use restrictions.
- Treatment of the Yorktown aquifer through deep extraction wells that pump the groundwater to an onsite treatment system where metals are removed via clarification/filtration and organic compounds are removed via air stripping and carbon adsorption.

Area A2

- A pilot study in this area showed that DPVE was an ineffective treatment due to the lack of identifiable contaminants observed in the extracted groundwater or soil vapors and the low hydraulic conductivity of the soil matrix. Therefore, institutional controls were implemented and the shallow groundwater in this area is extracted through conventional pumping for treatment by the onsite system.
- Implementation of institutional controls for the Yorktown aquifer as the plume is not expected to migrate offsite.

Area B

- Treatment of soil via hotspot removal and offsite disposal of the contaminated soil and debris.
- Extraction and treatment of both the shallow and deep aquifer and implementation of institutional controls.

Construction of the groundwater extraction and treatment system was initiated in 1997 and continuous operation of the Camp Allen Treatment Plant began in November 1998. Figures 3-2 and 3-3 illustrate the layout of the system with associated shallow and deep monitoring well and surface water sampling locations. The DPVE system was completed and began operation in May 1998. Groundwater samples were collected from monitoring wells in March 1997 and June 1998 to provide baseline information on water quality before the extraction system was started. The extraction wells were sampled in August 1997 to provide information on water quality prior to system startup. Ecological sampling of surface water and sediment was performed in fall 1997.

3.1.2 Operation and Maintenance

The standard operation and maintenance of the DPVE and groundwater extraction treatment systems is documented in the Operations and Maintenance Manual for Soil and Groundwater Remedial Action (OHM Remediation Services Corp., August 1997). The operation of the groundwater extraction system was modified to include precipitation of dissolved inorganics in the groundwater to prevent fouling of the system.

3.1.3 Current Status

In accordance with the Decision Document, the Camp Allen Landfill is part of the LTM program at NSN. The long-term monitoring plan for the Camp Allen Landfill groundwater remediation system requires sampling of monitoring wells and surface water locations until action levels are met or until the concentrations of the contaminants of concern reach asymptotic levels. Four rounds of sampling were completed in May 1999, March 2000, March 2001, and March 2002. An aquifer pumping test study was conducted during summer 2000 and groundwater modeling was completed that fall to assess the extent of the capture zones for the individual extraction wells. A subgroup was developed to evaluate the overall effectiveness and potential for optimization of the groundwater remediation system at Camp Allen Landfill. In addition, the system operational data collected by OHM Remediation Services Corp. (OHM) are reviewed quarterly to assess the performance of the remediation system. The results of the monitoring are summarized in Section 5 of this report and documented in the *Final 2001 Annual Long Term Monitoring Report* (CH2M HILL, June 2002).

3.2 Site 2—NM Area Slag Pile

3.2.1 Remedy Selection and Implementation

The FS was submitted in 1998 (CH2M HILL, September 1998) and the PRAP was issued in 1999 (CH2M HILL, January 1999). The Remedial Action Design was completed in 1999 (CH2M HILL, September 1999). and the ROD (CH2M HILL, October 2000) was signed in December 2000. The purpose of the remedial action at the site was to control exposure to contamination present in the soil, groundwater, surface water, and sediment. The remedial action consisted of the following objectives:

- Excavation and subsequent offsite disposal of contaminated sediment in the drainage channel adjacent to the site.

- Placement of an asphalt and soil cover to reduce exposure to site contaminants and provide for site reuse as a parking area.
- Stabilization of the bank of the drainage channel to prevent soil erosion from the slag pile into the drainage channel.
- Incorporation of land use controls prohibiting the excavation or disturbance of the site, the use of groundwater for drinking water, or disturbance of the monitoring system.
- Implementation of LTM annually for 5 years, and once every 5 years thereafter.

Approximately 1,600 tons of sediment were removed in November 1999 to achieve a lead cleanup goal of 218 mg/kg. The cleanup goal is based upon the Effects Range-Median (ERM) concentration for lead defined as the concentration of a contaminant in sediment at which adverse biological effects to living resources may be observed at a 50 percent rate. (Figure 3-4 illustrates the boundaries for the sediment removal action at the site.) Lead was found in all of the soil samples and is considered the indicator parameter for the COCs. Since it was co-located with the other COCs, the removal of lead to the established cleanup level was expected to remove the other elevated contaminants posing a risk.

The asphalt and soil cover was completed in February 2000. The cover consisted of a minimum of 2 inches of asphalt placed over the original gravel parking lot, and a minimum of 22 inches of soil cover (18 inches of soil plus 4 inches of topsoil) that was placed over the grassy field. The extent of the cover is shown in Figure 3-4. In addition, a 100-foot section of the west bank of the drainage channel was regraded, seeded, and covered with matting to prevent erosion of site materials.

3.2.2 Operation and Maintenance

Current site maintenance consists of periodically mowing the cover of the grass field.

3.2.3 Current Status

As a requirement of the ROD, the NM Slag Pile is part of the LTM program at NSN. Sediment, surface water, and groundwater samples are collected annually to monitor the levels of inorganics at the site and determine if these constituents are migrating offsite into the adjacent drainage channel. The sampling locations are shown on Figure 3-4. The first three rounds of sampling were completed in October 2000, May 2001, and June 2002 and are summarized in Section 5 of this report and documented in the *Final 2001 Annual Long Term Monitoring Report* (CH2M HILL, June 2002). Additionally, the grass at the site is maintained as a part of the NSN Grass Maintenance Contract.

3.3 Site 3—Q Area Drum Storage

3.3.1 Remedy Selection and Implementation

In 1986, Navy fire inspectors expressed concern with the oil-saturated soils at the northern end of the storage area (previously used to store damaged or leaking drums). On the basis of a potential fire hazard, the top 6 inches of soil were excavated from an area of 4,240 square yards (totaling approximately 750 cubic yards of soil removed) in the northern

section and disposed offsite in 1987 (Malcolm Pirnie, May 1988). Following the removal action, this area of the storage yard was paved. The extent of the soil removal is shown in Figure 3-5.

A DD (Environmental Science & Engineering, Inc., November 1996) for the site was signed in November 1996 to treat the groundwater and prevent offsite migration of the plume. The remedial action consisted of the installation of an air sparge (AS) and soil vapor extraction (SVE) system in AOC 1 and AOC 2. The system is comprised of 30 AS wells and 14 SVE wells in AOC 1 and 20 AS wells and 10 SVE wells in AOC 2. The layout of the treatment systems and associated monitoring wells for AOC 1 and AOC 2 are shown in Figures 3-6 and 3-7, respectively. The remediation system began operation in August 1998. Several monitoring wells were sampled for VOCs in February and May 1998 to provide baseline water-quality data before the remediation system was started.

3.3.2 Operation and Maintenance

The standard operation and maintenance of the air sparge/soil vapor extraction system is documented in the Environmental Facility User Manual for Groundwater Remediation (OHM Remediation Services Corp., August 1998). Based on the significant reduction of VOC concentrations during the first year of operation, the system operation was modified in September 1999. The SVE system was shut off and the operation of the AS system was altered to a 2-week cycle of pulsing.

3.3.3 Current Status

As a requirement of the Decision Document, the Q-Area is part of the LTM program at NSN. The monitoring plan currently includes the biannual sampling of 15 monitoring wells for VOCs and TPH. The first seven rounds of monitoring were completed in February and August 1999, March and August 2000, February and December 2001, and February 2002. A subgroup was developed to evaluate the overall effectiveness and potential for optimization of the groundwater remediation system at Q-Area. The system operational data collected by OHM and the monitoring data collected by CH2M HILL are reviewed by the subgroup quarterly so that the system operations and monitoring program can be promptly adjusted as necessary. The 2001 monitoring results are summarized in Section 5 of this report and documented in the *Final 2001 Annual Long Term Monitoring Report* (CH2M HILL, June 2002).

3.4 Site 6—CD Landfill

3.4.1 Remedy Selection and Implementation

A Decision Document was issued for the sediments (OU 1) at the CD Landfill in October 1996. Its purpose was to reduce the risk to ecological receptors by removing sediments that exceeded the ERM levels. As shown in Figure 3-8, partial removal of the contaminated sediments was conducted in fall 1997. When the cap for the CD Landfill was designed, the cap was extended to cover the remaining sediments.

The PRAP (Baker Environmental, Inc., June 1998) and ROD (Baker Environmental, Inc., September 1998) for the CD Landfill were issued in 1998 to address soil and groundwater (OU2) at the site. The purpose of the remedial action was to reduce the hazards to human

health and the environment by eliminating exposure to the soil and limiting the leaching of contaminants from the landfill into the groundwater. This was accomplished with a combination of a landfill cap, restricted access to the site, and institutional controls prohibiting access to the site and restricting future uses.

As outlined in the Landfill Closure Certification Report (CH2M HILL, August 2000), construction of the cap was initiated in May 1999 and completed in June 2000. The cap's extent is shown on Figure 3-8. Construction began with a final grading of the waste and installation of a 6-inch bedding layer to support the cover material. Following placement of the bedding layer, an impermeable barrier membrane was installed to prevent infiltration of water into the landfill material. A geocomposite drainage layer was also placed to provide adequate drainage of the cover and prevent water pressure from causing slope stability problems. The drainage layer is covered with a minimum of 24 inches of soil. This soil layer consists of 18 inches of onsite material overlain by 6 inches of topsoil to provide adequate nutrients to support the vegetation necessary to prevent erosion of the landfill cover.

3.4.2 Operation and Maintenance

Operations and maintenance at the site consists of periodic mowing of the vegetative cover as well as inspections of the landfill cover and institutional controls. The PWC conducts quarterly inspections occur and an outside contractor does so annually. The most recent inspection (July 2002) concluded that the remedy is protective of human health and the environment.

3.4.3 Current Status

As a requirement of the Virginia Solid Waste Management Regulations, Part D of 9 VAC 20-80-270, the CD Landfill is currently part of the LTM program at NSN. A total of three surface water locations and eight monitoring wells located upgradient, downgradient, and proximal to the site boundary (Figure 3-8) are monitored biannually to evaluate the effectiveness of the cover and determine if the landfill contaminants are migrating offsite. The initial 2 years of monitoring have been completed and are summarized in Section 5 of this report and documented in the *Annual Post-Closure Monitoring Report for 2001* (CH2M HILL, February 2002).

3.5 Site 20—LP 20 Site

3.5.1 Remedy Selection and Implementation

The Decision Document (Baker Environmental, Inc., February 1996) for the LP-20 site required that contamination at the site be treated to reduce the threat to human health and the environment. As the site is highly industrialized, it is effectively capped by asphalt and concrete, eliminating direct exposure pathways. The goal of the remedial action was to treat the contaminant plume in the shallow aquifer using an air sparge/soil vapor extraction system to prevent migration of the plume offsite and into the deep aquifer, and reduce the contaminant concentrations to established cleanup goals. In addition, aquifer use restrictions (for both the shallow and deep aquifer) were mandated to prevent the use of the groundwater.

The construction of the treatment system was completed and began operating on April 14, 1998. The shallow aquifer is treated by an air sparging and soil vapor extraction system (Figure 3-9) consisting of 31 air injection wells and 21 vapor extraction wells. The system was placed throughout the center and downgradient extent of the contaminant plume. In addition, several monitoring wells were sampled for VOCs in February 1998 to provide baseline water-quality data before the remediation system was started. The groundwater cleanup goals were established based on risk exposure construction and utility workers who may be exposed to shallow groundwater.

3.5.2 Operation and Maintenance

The standard operation and maintenance of the air sparge/soil vapor extraction system are documented in the Environmental Facility User Manual for Groundwater Remediation (OHM Remediation Services Corp., March 1998). The operation of the AS/SVE system in Areas 1 and 2 was changed to a cycle of pulse pumping to increase the effectiveness of VOC removal.

3.5.3 Current Status

As a requirement of the Decision Document, the LP-20 site is part of the LTM program at NSN. Monitoring for LP-20 currently consists of an annual sampling of 15 wells in the shallow and deep aquifer to evaluate the levels of VOCs and determine if these constituents are migrating offsite or into the deep aquifer. The first five rounds of the monitoring program were completed in November 1998, May 1999, March 2000, April 2001, and February 2002. The monitoring results are summarized in Section 5 of this report and documented in the *Final 2001 Annual Long Term Monitoring Report* (CH2M HILL, June 2002).

3.6 Site 22—Camp Allen Salvage Yard

3.6.1 Remedy Selection and Implementation

The initial remedial action at CASY consisted of the non time-critical removal and offsite disposal of metals and PCB-contaminated soils. The PCB removal action began in August 1998. Additional delineation of site contaminants in 2001 identified six metals hotpots. As an interim measure, the Navy began removal of the hot spot soils in conjunction with the ongoing PCB removal action. The hot spot and PCB-contaminated soil removal continued through 2001 with the ultimate excavation of more than 16,000 cubic yards of material (Figure 3-10). The Navy revised the preliminary remediation goals based on the more comprehensive confirmation sampling associated with the PCB and hot spot removal action and the reasonably anticipated future land use. In conjunction with a VDEQ toxicological review and approval, the NSN Tier I Partnering Team agreed to revise the cleanup goals for the removal action.

The FS (Baker Environmental, Inc., January 2002) and EE/CA (Baker Environmental, Inc., April 2002) for the Camp Allen Salvage Yard have been completed. However, the ROD (Baker Environmental, Inc., May 2002) and PRAP (Baker Environmental, Inc., March 2002) are currently under review by the Navy and the USEPA at the time of this report. Even though the ROD has not been completed for CASY, the Navy has decided to include this site in this Five-Year Review at this time in an effort to perform an "installation wide" Five-

Year Review of all the sites at the Norfolk Naval Base in an efficient and systematic manner. The ROD calls for the use of a 1-foot-thick engineered cover to be placed over the soil of the salvage yard and the sediment in the pond area as well as the implementation of institutional controls to restrict access and use of the site. In addition, the Bousch Creek culvert that transects the site would be cleaned and repaired to prevent the migration of contaminants into the Creek. There were no unacceptable human health risks associated with groundwater use by anticipated future receptors. The groundwater is being treated as part of the ongoing groundwater remedial action for the Camp Allen Landfill, and will ensure that the site groundwater is treated to the same levels as that from the landfill. The soil cover was completed in July 2002 and the ballfield construction is expected to begin in December 2003.

3.6.2 Operation and Maintenance

The remedy is currently under construction at the CASY.

3.6.3 Current Status

As of July 2002, the construction of the engineered soil cover has been completed. Additionally, the sediment has been removed from the Bousch Creek culvert, which was lined with fiberglass. Finally, the NSN Tier I Partnering Team has agreed to proceed with the proposed cover for the sediments in the pond.

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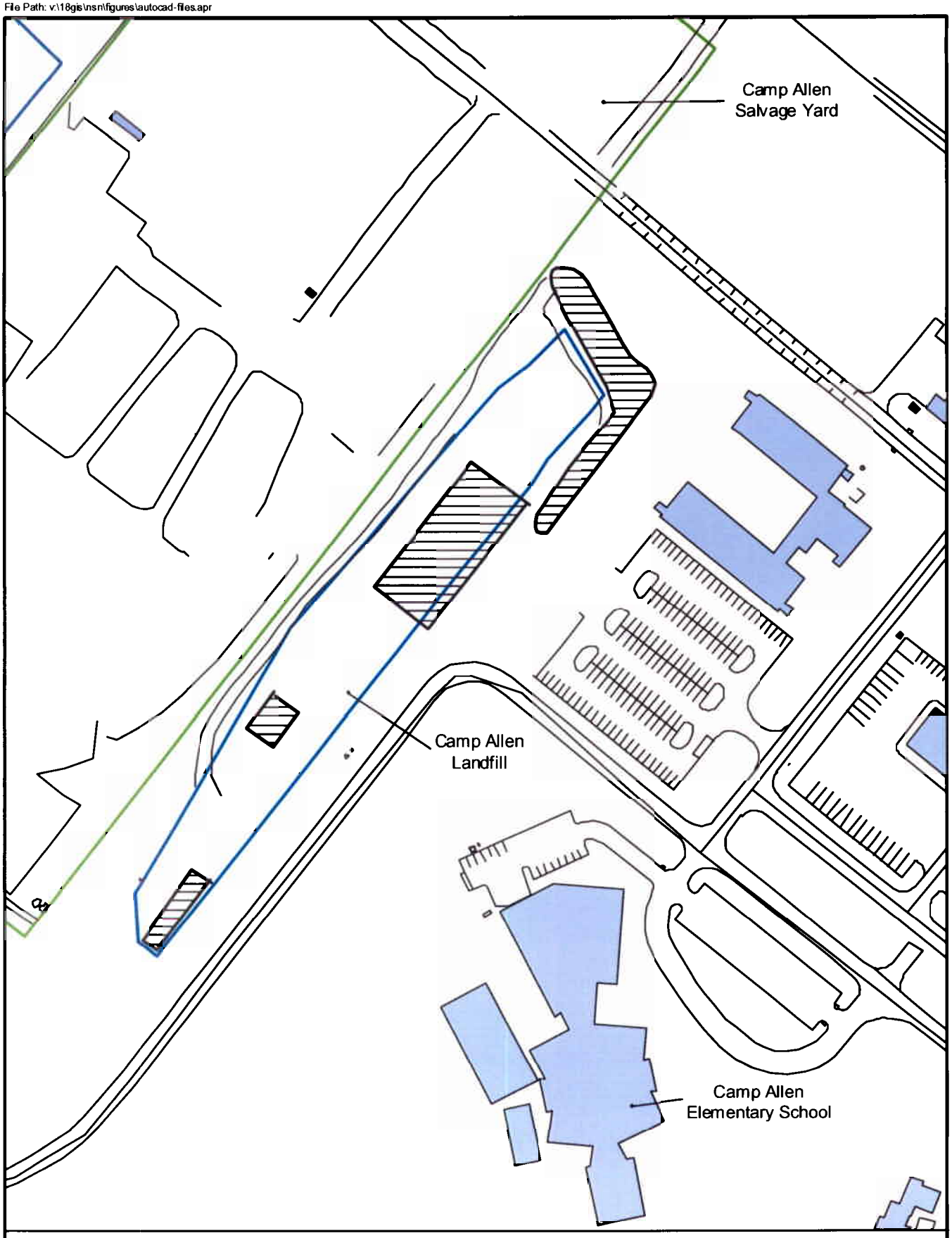
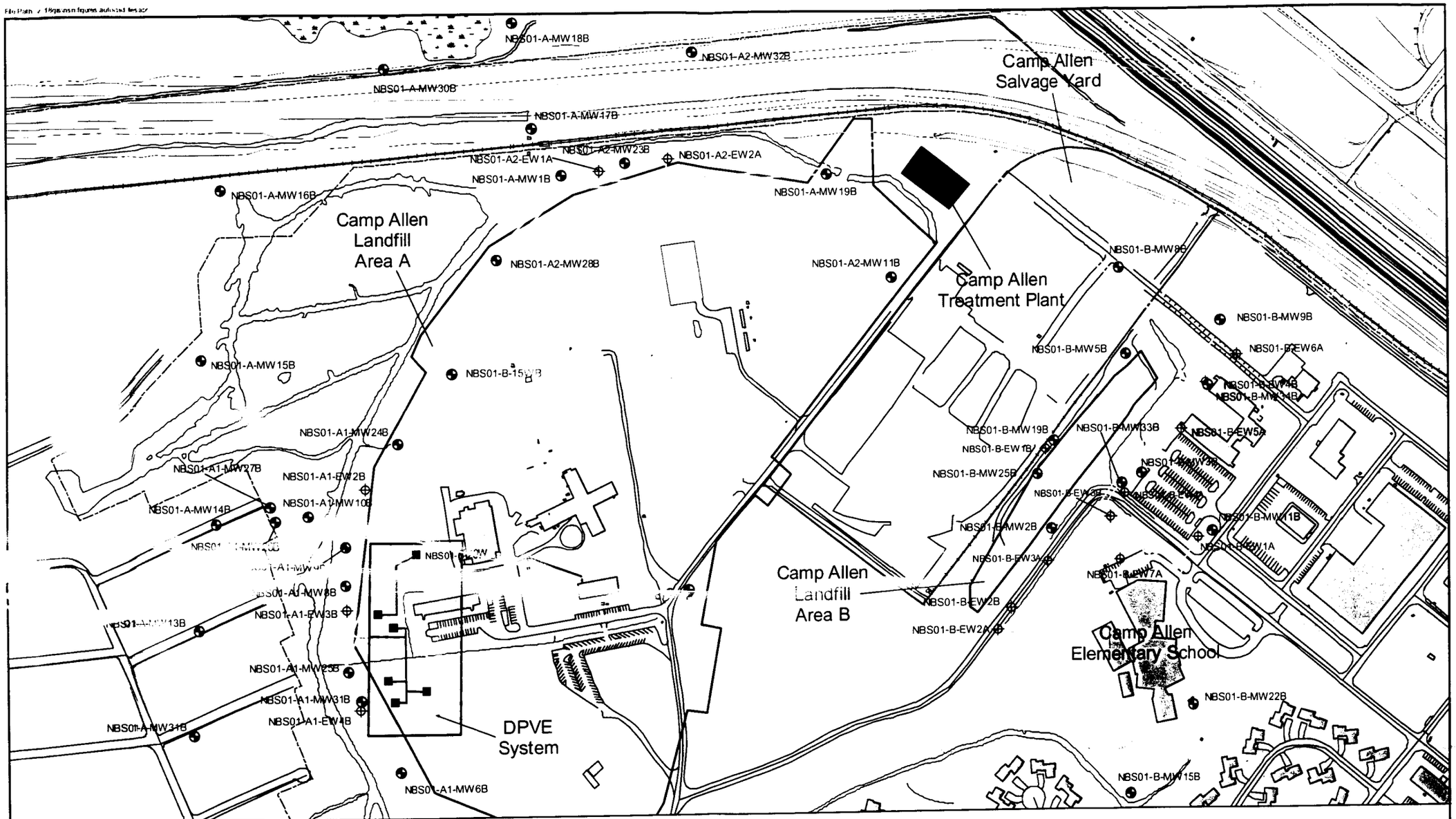


Figure 3-1
Areas of Excavation
Site 1 - Camp Allen Landfill, Area B
Naval Station Norfolk
Norfolk, Virginia

CH2MHILL



LEGEND

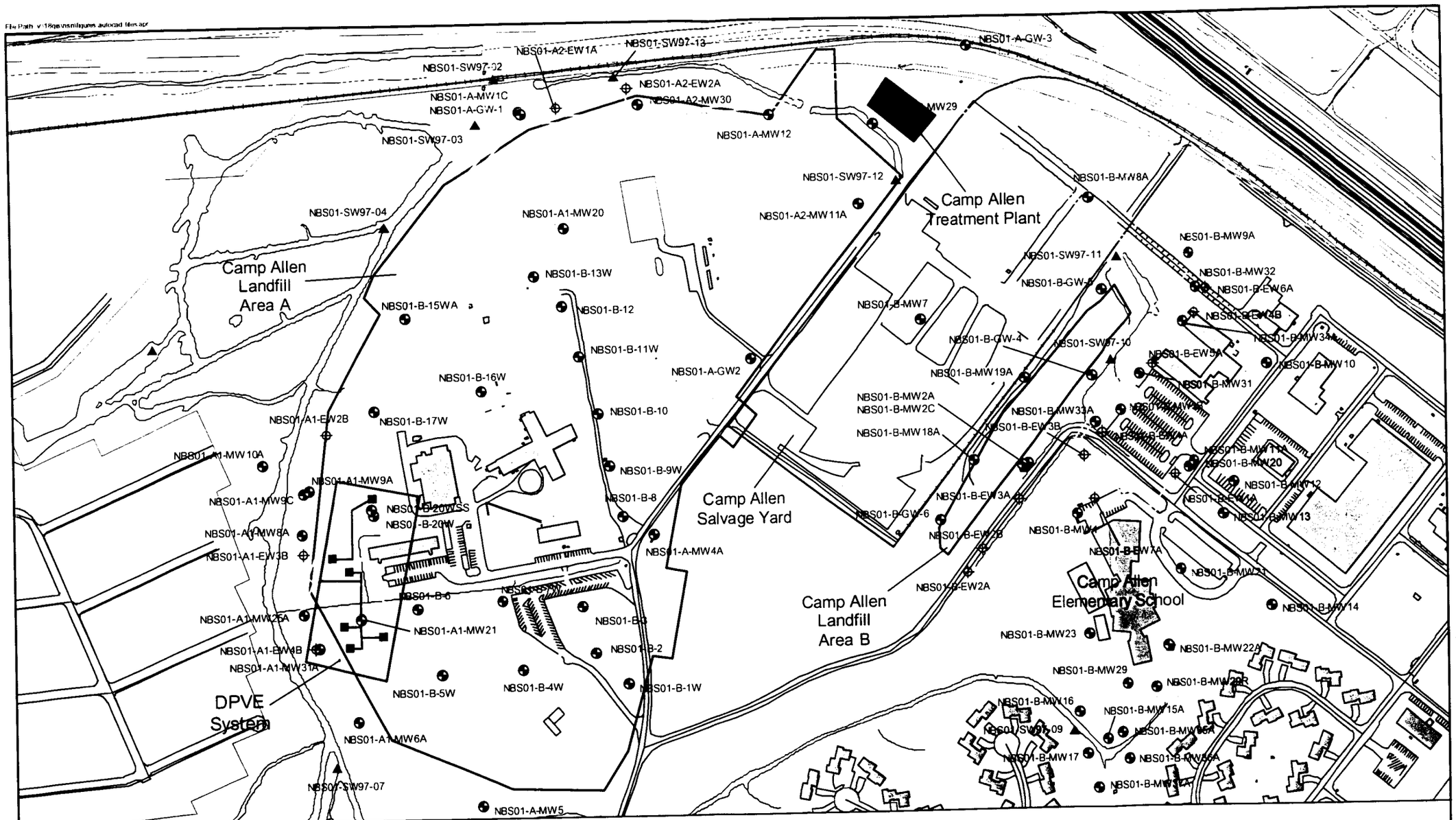
- Water Distribution Lines of Groundwater Extraction System
- Deep Monitoring Well
- Extraction Well
- DPVE System
- DPVE Well
- Camp Allen Landfill Boundary
- Camp Allen Salvage Yard Boundary

N

0 200 400 Feet

Figure 3-2
Layout of the Groundwater Extraction and Deep Monitoring Wells
Site 1 - Camp Allen Landfill
Naval Station Norfolk
Norfolk, Virginia

CH2MHILL



LEGEND

- Water Distribution Lines of Groundwater Extraction System
- Shallow Monitoring Well
- Extraction Well
- DPVE System
- DPVE Well
- Surface Water Locations
- Camp Allen Landfill Boundary
- Camp Allen Salvage Yard Boundary

N

0 200 400 Feet

Figure 3-3
Layout of the Groundwater Extraction System and Shallow Monitoring Wells
Site 1 - Camp Allen Landfill
Naval Station Norfolk
Norfolk, Virginia

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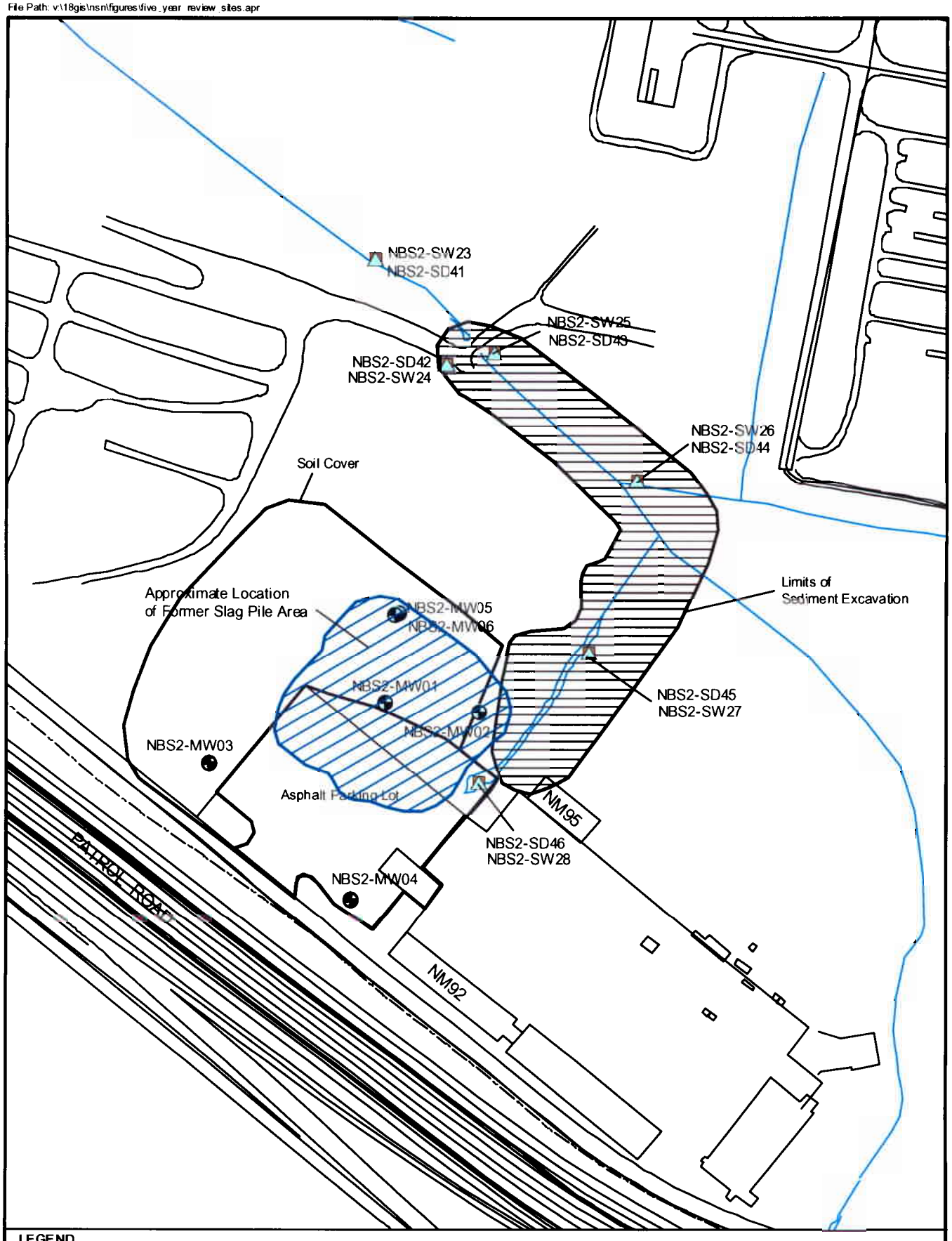

Figure 3-4
Soil Cover and Limits of Sediment Excavation
Site 2 - Former NM Slag Pile
Naval Station Norfolk
Norfolk, Virginia

CH2MHILL

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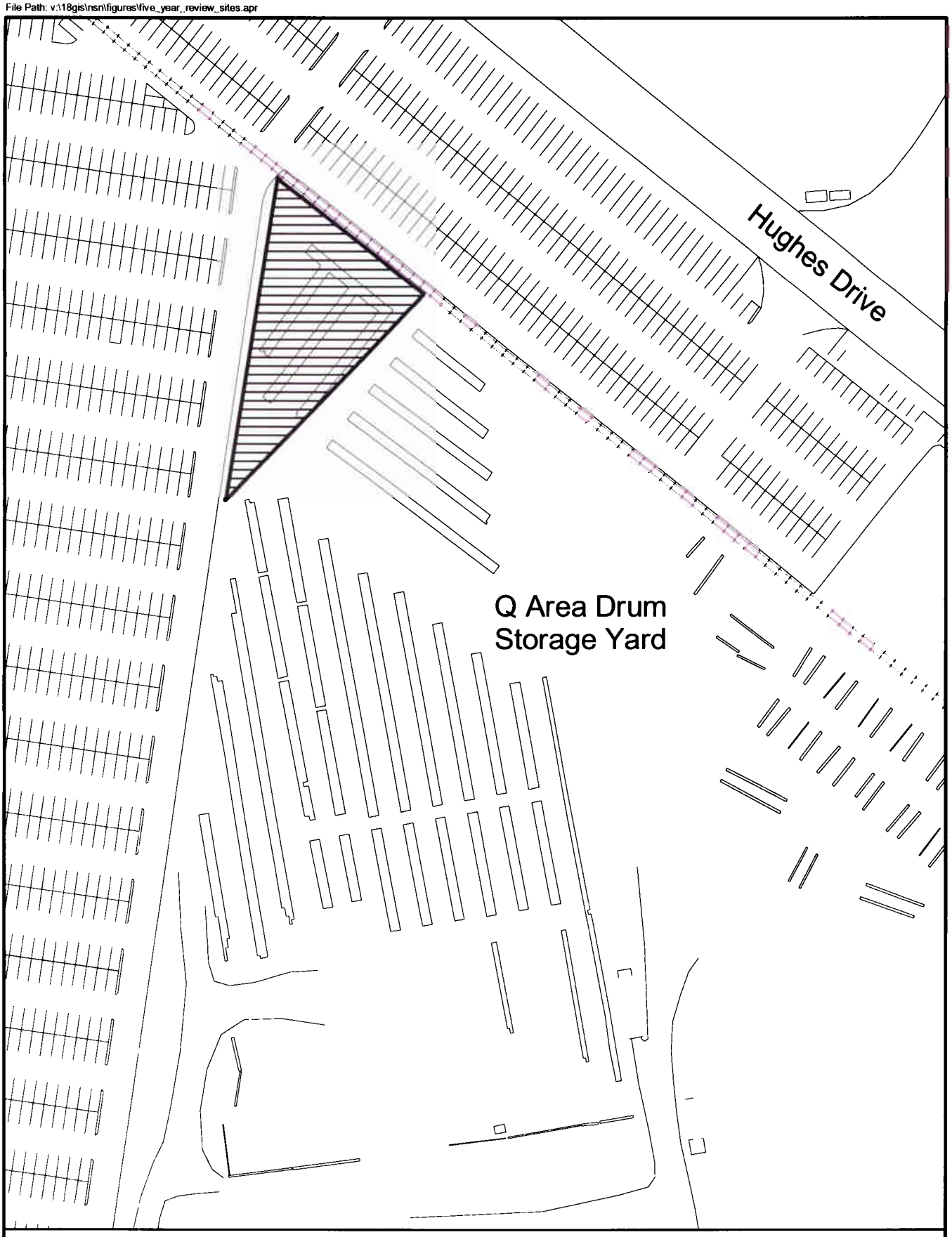

Figure 3-5
Area of Contaminated Soil Removal
Site 3 - Q Area Drum Storage Yard
Naval Station Norfolk
Norfolk, VA

CH2MHILL

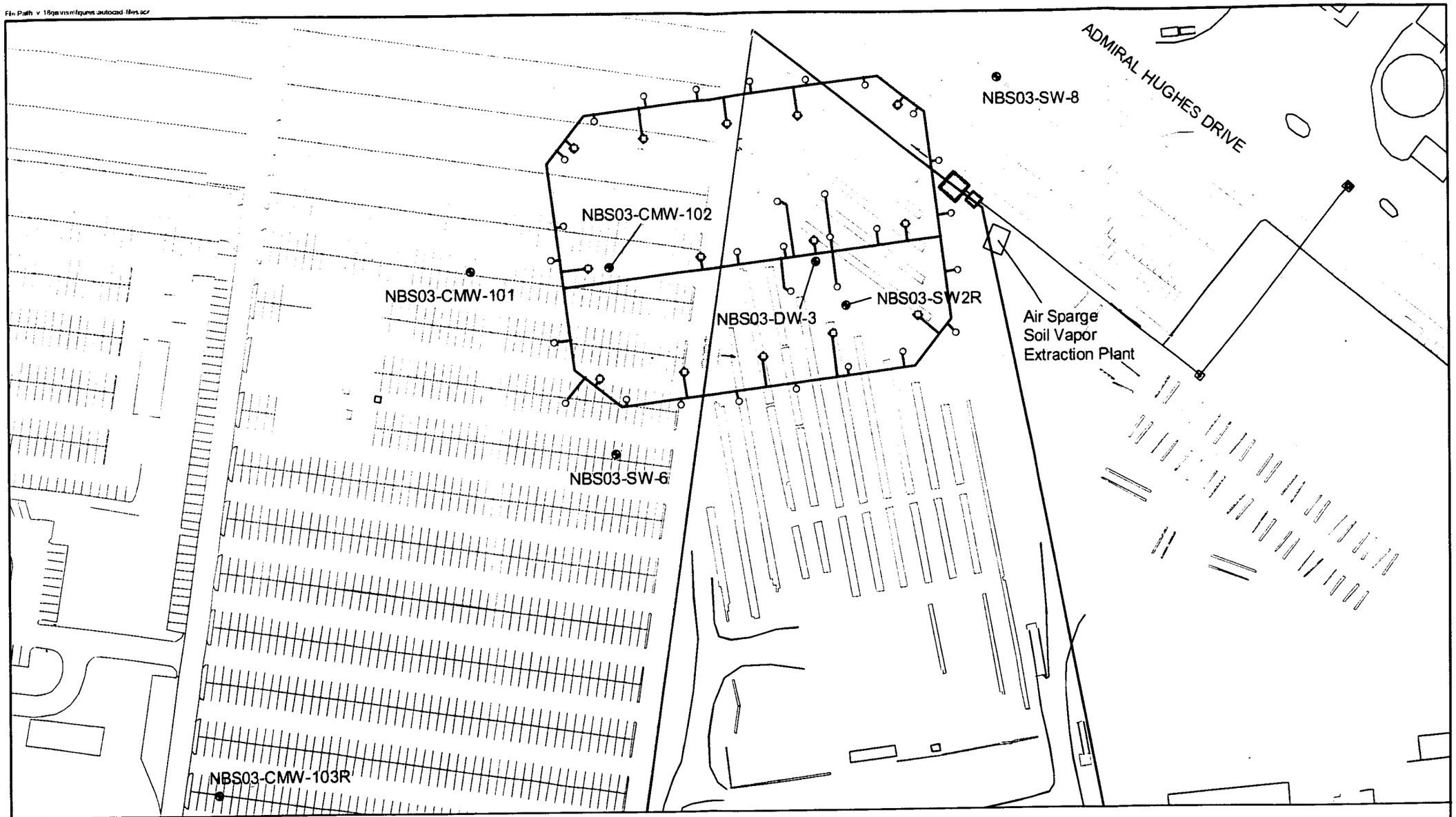

Figure 3-6
Diagram of the Air Sparge / Soil Vapor Extraction System and Associated Monitoring Wells
Site 3, Q Area Drum Storage Yard, AOC 1
Naval Station Norfolk
Norfolk, Virginia

CH2MHILL

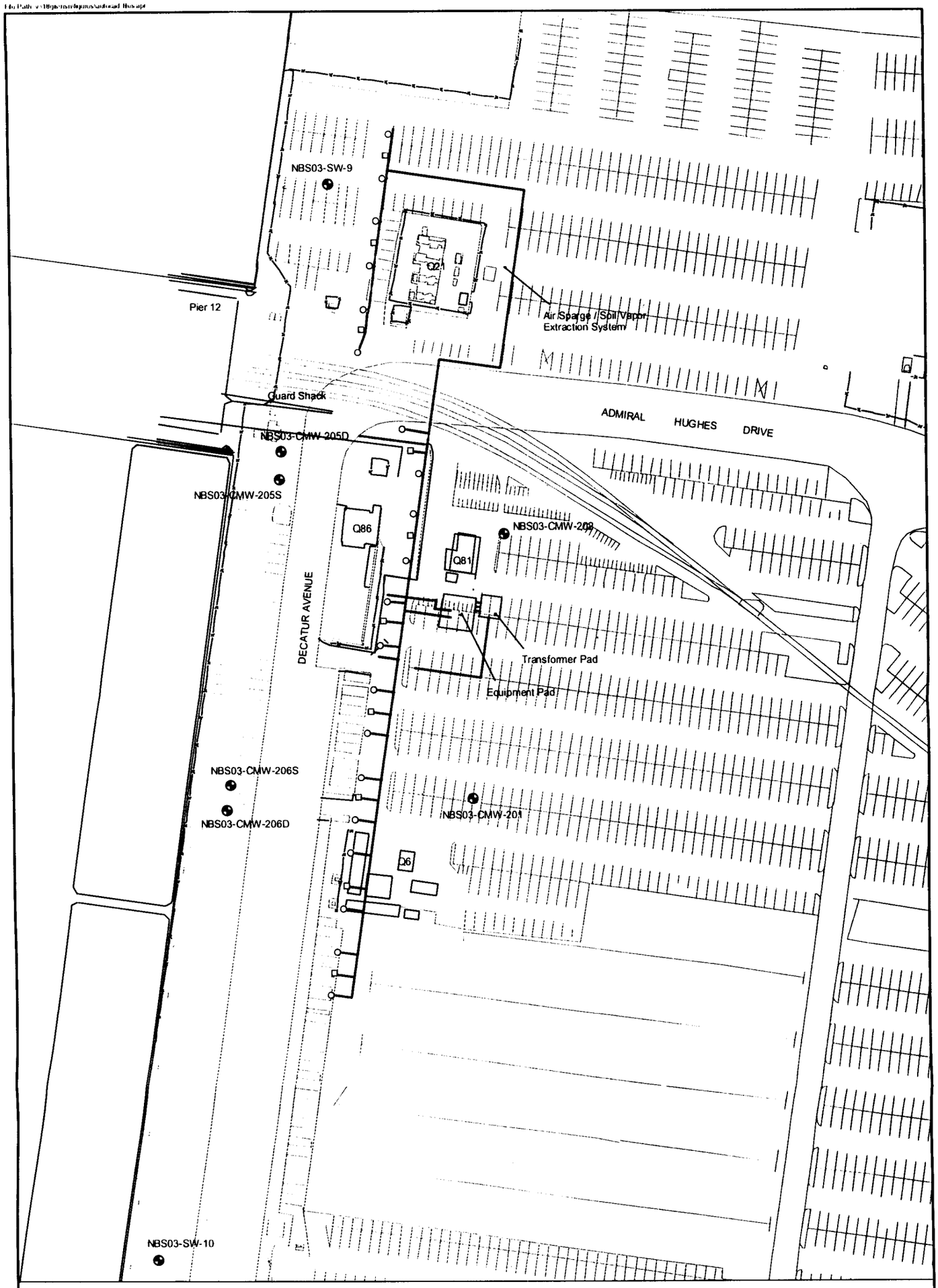

Figure 3-7
Diagram of the Air Sparge / Soil Vapor Extraction System and Associated Monitoring Wells
Site 3 - Q Area Drum Storage Yard / AOC 2
Naval Station Norfolk
Norfolk, Virginia

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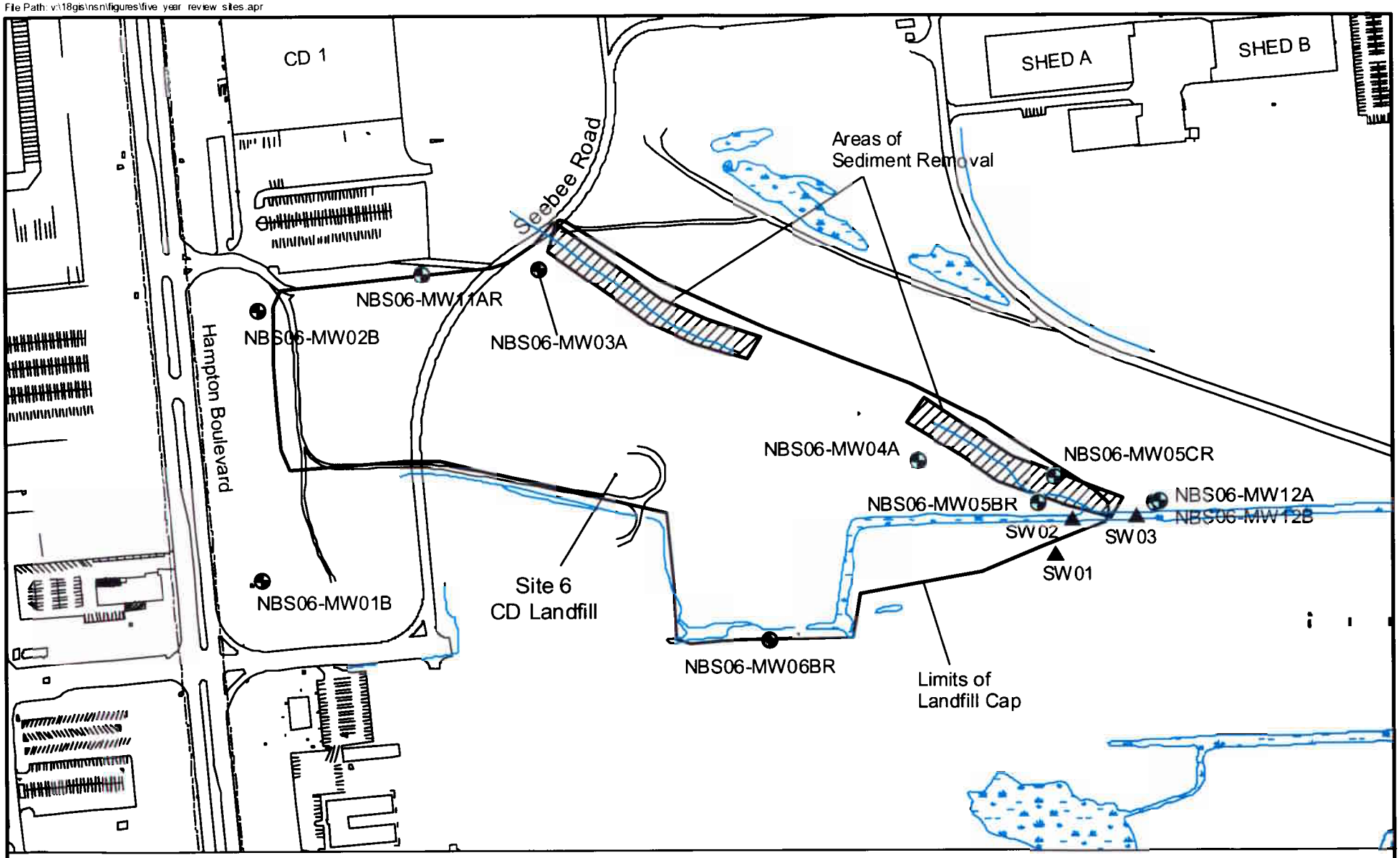

Figure 3-8
Areas of Sediment Removal and Landfill Cap
Site 6 - CD Landfill
Naval Station Norfolk
Norfolk, Virginia

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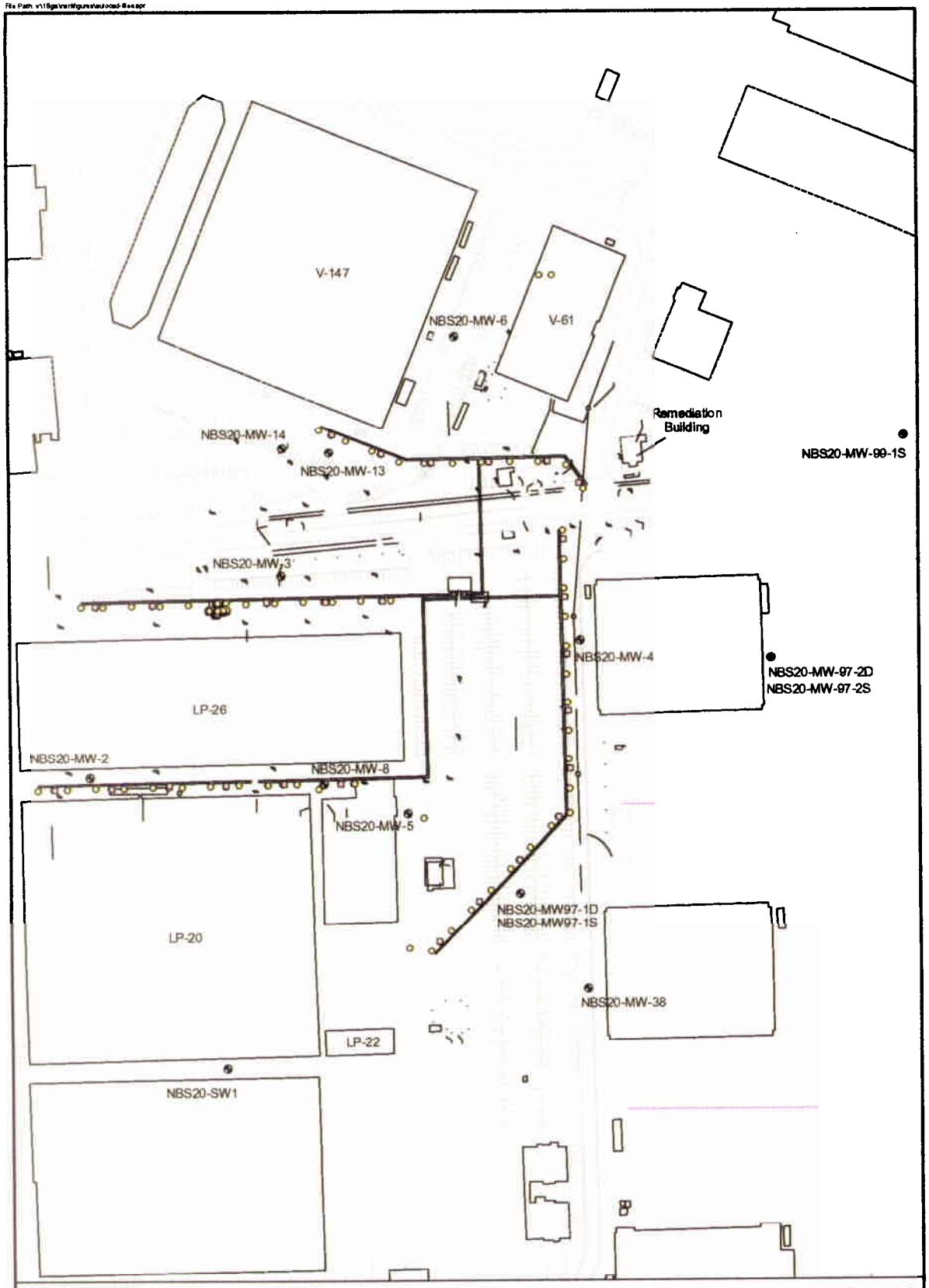

Figure 3-9
Diagram of the Air Sparge / Soil Vapor Extraction System and Associated Monitoring Wells
Site 20 - Building LP-20
Naval Station Norfolk
Norfolk, Virginia
CH2MHILL

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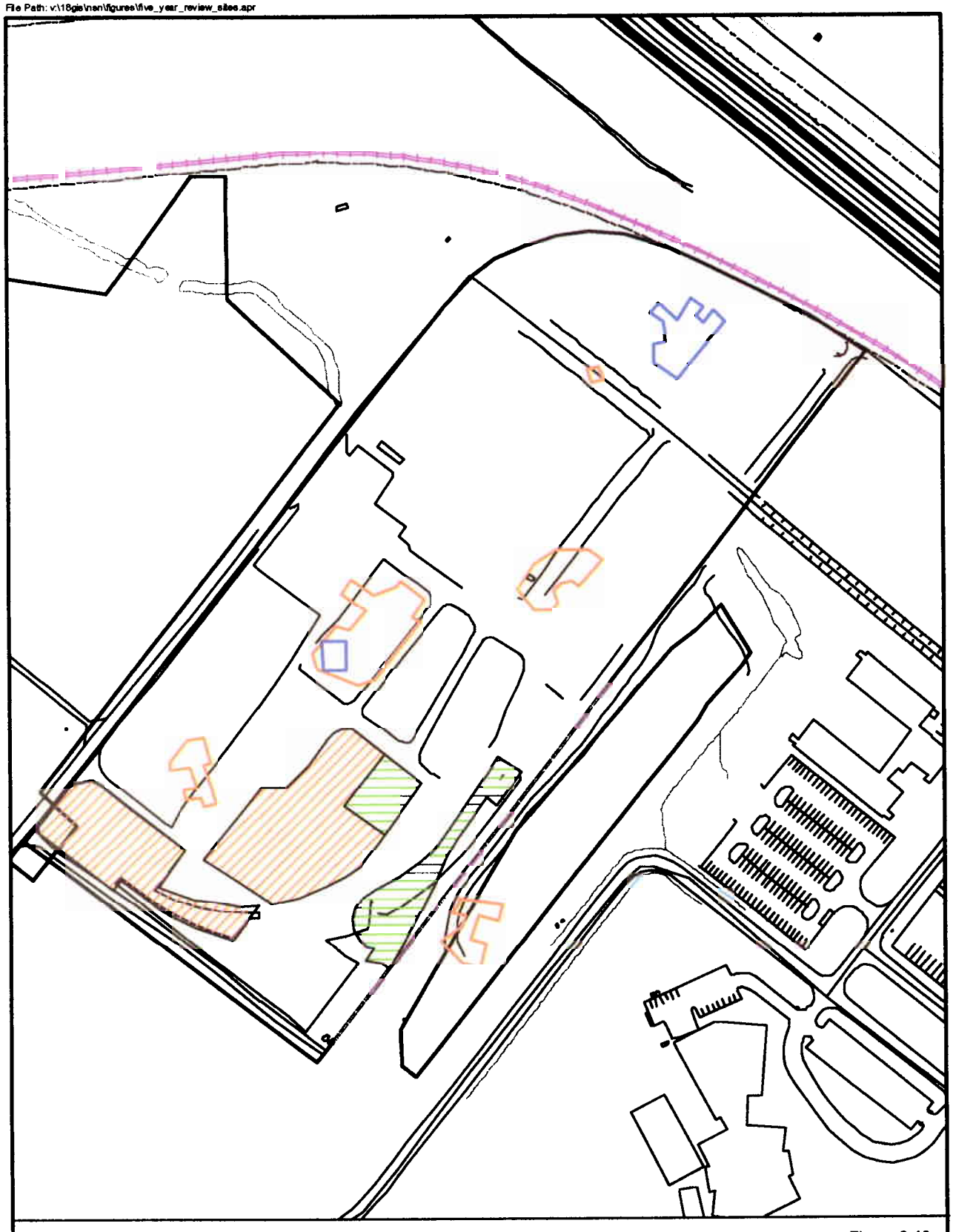


Figure 3-10
Areas of Contaminated Soil Removal
Site 22 - Camp Allen Salvage Yard
Naval Station Norfolk
Norfolk, Virginia

CH2MHILL

4 Administrative Components of the Five-Year Review

The NSN Five-Year Review Team is led by Ms. Winoma Johnson, Navy technical representative for the Installation Restoration Program (IRP). The Team established the review schedule that began in July 2002 and extended through November 2002. The following activities were conducted as part of the Five-Year Review process:

- Community involvement
- Interviews
- Site inspections
- Applicable or Relevant and Appropriate Requirements (ARARs) review

4.1 Community Involvement

The community was informed of the initiation of the Five-Year Review through a RAB meeting in June 2002. The findings of the Five-Year Review were presented at the November 2002 RAB meeting. Additionally, community interviews were conducted as part of the Community Relations Plan update and the results incorporated into the Final Five-Year Review Report.

4.2 Interviews

Operations and maintenance of the treatment systems at CALF, Q-Area, and LP-20 are currently under contract with Shaw E & I, Inc. An interview was conducted with Shaw E & I site Superintendent Mark Pisarcik during the site inspections of July 29 and August 5, 2002. A summary of the interviews is presented in Appendix A and significant findings are discussed in Sections 5 and 6 of this report.

4.3 Site Inspection

An inspection of the Five-Year Review sites was conducted on July 29 and August 5, 2002. The inspection checklists are presented in Appendix B and significant findings are discussed in Sections 5 and 6 of this report. Photos of significant features at the sites are provided in Appendix C.

4.4 ARARs Review

As required by the NCP, selected remedies must be in compliance with all "applicable or relevant and appropriate requirements" (ARARs). ARARs are the cleanup standards, standards of control, and other substantive environmental requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous

substance, pollutant, contaminant, remedial action, location, or other circumstance of a Superfund site. The ARARs for the site are reviewed in this section per site.

4.4.1 Site 1—Camp Allen Landfill

The Decision Document (Baker Environmental, Inc., July 1995) details the cleanup goals for the soil and groundwater. The soil goals were established to be protective of groundwater from potential migration of VOCs from the soil. The soil goals were modeled to attain groundwater concentrations at the MCLs. Therefore, the soil goals remain protective of human health and the environment.

The cleanup goals for the Yorktown aquifer were based on MCLs. There have been no revisions to the MCLs for the constituents of concern at CAL; therefore, the cleanup goals established for the Yorktown aquifer remain protective of human health and the environment.

The cleanup goals for the shallow aquifer were established as risk-based goals that would result in an acceptable risk for non-potable groundwater use by a child during outdoor activities (lawn watering or car washing). Additionally, the shallow aquifer is not to be used as a potable supply based on a City of Norfolk ordinance prohibiting the use of the water table aquifer for public or private potable water supplies under Ordinance Chapter 46.1, Reference 46.1-5. The Ordinance requires that all potable water in the City of Norfolk come from the City's water supply system. Anyone violating the Ordinance will be guilty of a Class-1 misdemeanor. The groundwater beneath the site is not to be used as a potable supply based on the City of Norfolk ordinance and land use controls to be implemented by NSN.

4.4.2 Site 2—NM Area Slag Pile

The soil cleanup goal for lead at the Slag Pile site was based on ecological receptors. The goal is 218 mg/kg which is the ecological Effects Range—Median (ERM). This standard remains protective of both human health and the environment.

4.4.3 Site 3—Q Area Drum Storage

The Decision Document (Environmental Science & Engineering, Inc., November 1996) summarized the remedial action and goals for the groundwater and soil at the Q Area Drum Storage. The groundwater goals were established to be protective of the future worker from inhalation of indoor air that may contain volatile organics migrating from the groundwater. The risk-based groundwater remediation goals are more conservative than the MCLs for all constituents except tetrachloroethne and trichloroethene. However, given that the shallow groundwater is not to be used as a potable supply based on a City of Norfolk ordinance and land use controls to be implemented by NSN, the groundwater goals are still considered to be protective of human health.

A soil remediation goal was established for thallium, based on potential exposure to ecological receptors. However, the site is currently covered with an asphalt parking area. Based on the lack of complete exposure pathway to the ecological receptors, the soil goal is still considered to be protective of the environment.

4.4.4 Site 6—CD Landfill

The Record of Decision (Baker Environmental, Inc., September 1998) summarized the cleanup goals for the groundwater and surface water monitoring for 1,4-dichlorobenzene and chlorobenzene of 39 µg/l and 0.44 µg/l, respectively. These goals were established based the USEPA Region III Risk-Based Concentrations (RBCs) for the protection of human health. The RBCs are based on a residential receptor using the water as a potable supply. Therefore, the performance standards remain protective of human health and the environment. Additionally, 1,4-dichlorobenzene and chlorobenzene were not detected in either the groundwater or surface water during the 2000 and 2001 monitoring events and subsequently, DEQ has approved exclusion of VOCs from the monitoring program.

Additionally, the groundwater monitoring program included the collection of groundwater quality parameters (hardness, TOC, TOX, specific conductivity, and pH) and groundwater contamination indicator parameters (chloride, total/dissolved iron, total/dissolved lead, and total/dissolved sodium) in accordance with DEQ Regulation 9VAC20-80-270 D5. The analytical data are evaluated using a trend analysis to determine if there are significant changes in the concentrations of constituents over time. The use of trend analysis is still a valid approach for evaluation to determine if there is an improvement in the groundwater quality following the installation of the cap.

4.4.5 Site 20—LP 20 Site

The Decision Document (Baker Environmental, Inc., February 1996) details the cleanup goals that were established for the shallow and Yorktown Aquifers beneath the Building LP-20 Site. The cleanup goals were developed to be protective of the construction worker/utility worker non-potable exposure as the site is projected to be used for industrial purposes. The groundwater beneath the site is not to be used as a potable supply, given the City of Norfolk ordinance and land use controls to be implemented by NSN.

4.4.6 Site 22—Camp Allen Salvage Yard

The Draft Record of Decision (Baker Environmental, Inc., May 2002) is still being reviewed. The Draft ROD summarizes cleanup goals for the soil and groundwater. As the ROD is still in the review cycle and has not been finalized, it is assumed that the selected remedy will be in compliance with the current ARARs. Therefore, an ARAR evaluation for CASY was not conducted at this time.

5 Assessment

This section discusses the effectiveness of the remedial actions in achieving the goals established for each site.

5.1 Site 1—Camp Allen Landfill

5.1.1 Effectiveness of Remedy

Groundwater monitoring and flow modeling of the CALF were conducted to determine the effectiveness of the system in containing the VOC contaminant plume. The monitoring and modeling results are documented in the Annual Long-Term Monitoring report (CH2M HILL, June 2002). The report indicates that the groundwater remediation system has prevented the VOC plume from migrating towards the residential areas west and southeast of the site. The groundwater data from sentinel wells (wells located in the residential areas west of the landfill) have shown that contaminant levels remain below the MCLs. However, some monitoring wells located north of the site and outside of the extraction well capture zone demonstrated elevated levels of VOCs above the cleanup goals. Additional extraction wells are currently being installed to extend the capture zone to include this area.

5.1.2 Adequacy and Continued Needs for O&M

An inspection of the site conducted on July 29 and August 5, 2002 indicated that the treatment systems are in generally good condition and operating as designed. However, the shallow extraction wells in Area A (A2-EW1A and A2-EW2A) are not operating due to the low hydraulic conductivity of the shallow aquifer soils. In addition, deep extraction well A1-EW2B was damaged due to a collapse of the well casing and is currently not in operation. Furthermore, ferric chloride has been added to the treatment system to precipitate the metals in the groundwater to prevent them from fouling the system. Additional details are available in the interview and site inspection checklists in Appendixes A and B, respectively.

5.1.3 Achievement of Remedial Action Objectives/Cleanup Goals

Figures 5-1 and 5-2 show the locations of the monitoring wells that exceed the cleanup goals in the shallow and deep aquifer, respectively. The monitoring wells located in the shallow aquifer adjacent to the source area of the Area B landfill have shown a more than 50-percent reduction in VOC concentrations since the system's startup. The deep monitoring wells in Area B generally showed a trend of significant increase in VOC concentrations after the startup of the treatment system in 1998. However, this increase can be attributed to the downward vertical migration of the contaminants due to the greater hydraulic conductivity of the deep aquifer. The VOC concentrations in the deep monitoring wells have been reduced by more than 50 percent since the initial startup of the treatment system.

The shallow wells in the Area A landfill and the deep monitoring wells to the north of Area A have shown no significant decrease in the concentrations of the VOC constituents.

However, the deep monitoring wells on the western border of the Area A landfill have demonstrated a decrease of greater than 50 percent in the VOC concentrations.

5.1.4 Opportunities for Optimization

The groundwater modeling showed that the VOC plume in the shallow and deep aquifers has been captured and has not migrated into the adjacent residential areas. The majority of the plume is contained by the deep extraction wells because of the significant inter-connection between the deep and shallow aquifers. Options for optimization of the system as identified by the subgroup are currently being evaluated and include:

- Eliminate pumping from the shallow extraction well locations that do not contribute to the capture zone and have adjacent monitoring wells that meet the cleanup criteria.
- Consider increasing the pumping rates for Area B shallow extraction wells to enhance VOC mass reduction.
- Extend the capture zone for deep groundwater in Area A to contain the entire plume by modification of the existing extraction system.
- Determine minimum-pumping rates needed to maintain the capture zone in the deep aquifer to reduce downward vertical flow.
- Evaluate effectiveness of dual-phase system.
- Evaluate final monitoring requirements for containment and mass reduction in hot spots.

The specific steps to be implemented at CALF are described further in Sections 6 and 7. The system will continue to be evaluated by the subgroup for effectiveness and to identify any potential optimization strategies.

5.1.5 Changes in ARARs or Other Risk-Related Factors

There are no changes in the ARARs or other risk-related factors.

5.1.6 Changes in Known Contaminants, Sources, or Pathways at the Site

Two isolated locations with VOC concentrations above the cleanup criteria were observed in the recent rounds of monitoring data. One location is associated with well B-MW15A located at the Camp Allen Landfill Area B. The second location is associated with well B-20W located west of the brig and proximal to the DPVE system. These problems are currently being solved by the installation of additional extraction wells and modifications to the DPVE system. This is discussed in greater detail in Sections 6 and 7.

5.2 Site 2—NM Area Slag Pile

5.2.1 Effectiveness of Remedy

The combination of an asphalt and soil cover, as well as the implementation of institutional controls, effectively meets the remedial objectives to prevent exposure to soil, groundwater, surface water, and sediment.

5.2.2 Adequacy and Continued Needs for O&M

An inspection of the site conducted on July 29, 2002 indicated that the soil and vegetative cover, asphalt cover, and the bank of the drainage ditch are intact. Additional details are available in the site inspection checklist in Appendix B.

5.2.3 Achievement of Remedial Action Objectives/Cleanup Goals

A review of the latest data set (June 2002) indicates that the concentrations of inorganics in the groundwater, surface water, and sediment have not increased in comparison to the baseline concentrations established prior to the remedial action. In addition, the concentration of lead in the sediment remains below the cleanup goal.

5.2.4 Opportunities for Optimization

There are currently no opportunities for optimization. The monitoring program will be evaluated annually to identify alternatives to more cost effectively meet the monitoring objectives for the site.

5.2.5 Changes in ARARs or Other Risk-Related Factors

There are no changes in the ARARs or other risk-related factors.

5.2.6 Changes in Known Contaminants, Sources, or Pathways at the Site

There have been no changes in known contaminants, sources, or exposure pathways.

5.3 Site 3—Q Area Drum Storage

5.3.1 Effectiveness of Remedy

The treatment system has significantly reduced the concentrations of the COCs at the site and prevented further migration of the contaminant plume.

5.3.2 Adequacy and Continued Needs for O&M

An inspection of the site conducted on July 29, 2002 indicated that the air sparge system is operating and in good condition. Additional details are available in the interview and site inspection checklists in Appendices A and B, respectively.

5.3.3 Achievement of Remedial Action Objectives/Cleanup Goals

A review of the latest data from December 2001 and February 2002 shows that the cleanup goals have been achieved in AOC 1 for all COCs except for a vinyl chloride hotspot observed downgradient of the area. The analytical data from AOC 2 demonstrated a decrease or stabilization in the concentration of the majority of the COCs. However, the levels of trichloroethene and vinyl chloride remain above the cleanup goals. Figures 5-3 and 5-4 show the locations of the monitoring wells that exceed the cleanup goals at AOC 1 and AOC 2, respectively.

5.3.4 Opportunities for Optimization

The soil vapor extraction system has been shut down in both AOC 1 and AOC 2 because the vapor levels became too low for practical use of the system. The air sparge system at AOC 2 is in constant operation; however, the system at AOC 1 is pulse pumped monthly (2 weeks on, 2 weeks off). The treatment at AOC 1 was changed to a cycle of pulse pumping to increase the efficiency of the system when the levels of VOCs became asymptotic under constant operating conditions.

The monitoring data indicate that the cleanup goals for all contaminants in AOC 1, with the exception of vinyl chloride, have been achieved. Therefore, the NSN Tier I Partnering Team joint scoped a closeout strategy for AOC 1 in July 2002. This is discussed in greater detail in Sections 6 and 7. The systems at both AOC 1 and AOC 2 will continue to be evaluated by the subgroup for effectiveness and to identify any potential optimization strategies.

5.3.5 Changes in ARARs or Other Risk-Related Factors

There are no changes in the ARARs or other risk-related factors.

5.3.6 Changes in Known Contaminants, Sources, or Pathways at the Site

There have been no changes in known contaminants, sources, or exposure pathways.

5.4 Site 6—CD Landfill

5.4.1 Effectiveness of Remedy

The combination of a landfill cover and institutional controls is effective in meeting the remedial objectives to prevent direct contact, inhalation, and ingestion of contaminated soil, groundwater, surface water, and sediment.

5.4.2 Adequacy and Continued Needs for O&M

The PWC conducts quarterly inspections and an outside contractor does so annually. The July 29, 2002 site inspection by identified some minor areas of erosion (opposite bank of drainage channel from the landfill) and sedimentation in the drainage pipes as minor maintenance issues at the CD Landfill. These issues are included in the site inspection checklist (Appendix B) and discussed in Sections 6 and 7.

5.4.2 Achievement of Remedial Action Objectives/Cleanup Goals

As a requirement of the Virginia Solid Waste Management Regulations, Part D of 9 VAC 20-80-270 the monitoring wells were sampled quarterly for Phase I groundwater contamination indicator parameters (specific conductivity, pH, total organic carbon, and total organic halogens) during the initial 2 years of LTM. In addition, based upon previous investigations, the samples were also analyzed for selected metals (iron, lead, and sodium), chloride, and hardness. Surface water samples and samples from two downgradient wells were also analyzed for chlorobenzene and 1,4-dichlorobenzene. The results of the initial 2-year LTM indicated that the remedy has reduced the concentrations of selected VOCs in the groundwater and surface water to below the detection limits.

During the third year of LTM, Phase II sampling was added at the upgradient and downgradient monitoring wells. The Phase II sampling includes the analysis of an additional 15 metals and 47 VOCs. Once a sufficient amount of data have been generated, a trend analysis will be conducted to evaluate the migration of contaminants offsite.

5.4.4 Opportunities for Optimization

As a result of consistent non-detect levels of VOCs during the first year of LTM, sampling of surface water has been discontinued. Based on the trend analysis, the data will be evaluated to assess if the monitoring program can be reduced to monitor for contaminant indicator and groundwater quality parameters only (Phase I sampling).

5.4.5 Changes in ARARs or Other Risk-Related Factors

There are no changes in the ARARs or other risk-related factors.

5.4.6 Changes in Known Contaminants, Sources, or Pathways at the Site

There have been no changes in known contaminants, sources, or exposure pathways.

5.5 Site 20—LP 20 Site

5.5.1 Effectiveness of Remedy

The treatment system has significantly reduced the concentrations of VOCs at the site.

5.5.2 Adequacy and Continued Needs for O&M

An inspection of the site conducted on July 29, 2002 indicated that the treatment systems are in good condition and operating as designed. Additional details are available in the interview and site inspection checklists in Appendixes A and B, respectively.

5.5.3 Achievement of Remedial Action Objectives/Cleanup Goals

Overall, the concentrations of COCs have decreased from the baseline data. These reduced concentrations indicate that the AS/SVE system is effectively remediating the contaminant plume. However, an increase in some of the COCs (dichloroethene and vinyl chloride) above the cleanup goals was observed at certain wells. The increase in these constituents likely result from the degradation of VOCs at the site. Figure 5-5 shows the locations of the monitoring wells that exceed the cleanup criteria at the LP-20 site.

5.5.4 Opportunities for Optimization

The AS/SVE system in Areas 1 and 2 was changed to a cycle of pulse pumping. The Areas are cycled 3 weeks on and 1 week off per month to increase the effectiveness of VOC removal. The AS/SVE system will continue to be evaluated by the subgroup for effectiveness and to identify any potential optimization strategies.

5.5.5 Changes in ARARs or Other Risk-Related Factors

There are no changes in the ARARs or other risk-related factors.

5.5.6 Changes in Known Contaminants, Sources, or Pathways at the Site

The concentrations of some VOCs have substantially increased in deep well MW97-2D, indicating some constituents may be migrating downgradient of the treatment system and into the Yorktown aquifer.

5.6 Site 22—Camp Allen Salvage Yard

5.6.1 Effectiveness of Remedy

The remedial action at CASY is under construction at the time of this review. The combination of a protective cover, institutional cover, and institutional controls is expected to be effective in meeting the remedial objectives to prevent direct contact, inhalation, and ingestion of contaminated soil, sediment, and groundwater.

5.6.2 Adequacy and Continued Needs for O&M

Not applicable at this time.

5.6.3 Achievement of Remedial Action Objectives/Cleanup Goals

Not applicable at this time.

5.6.4 Opportunities for Optimization

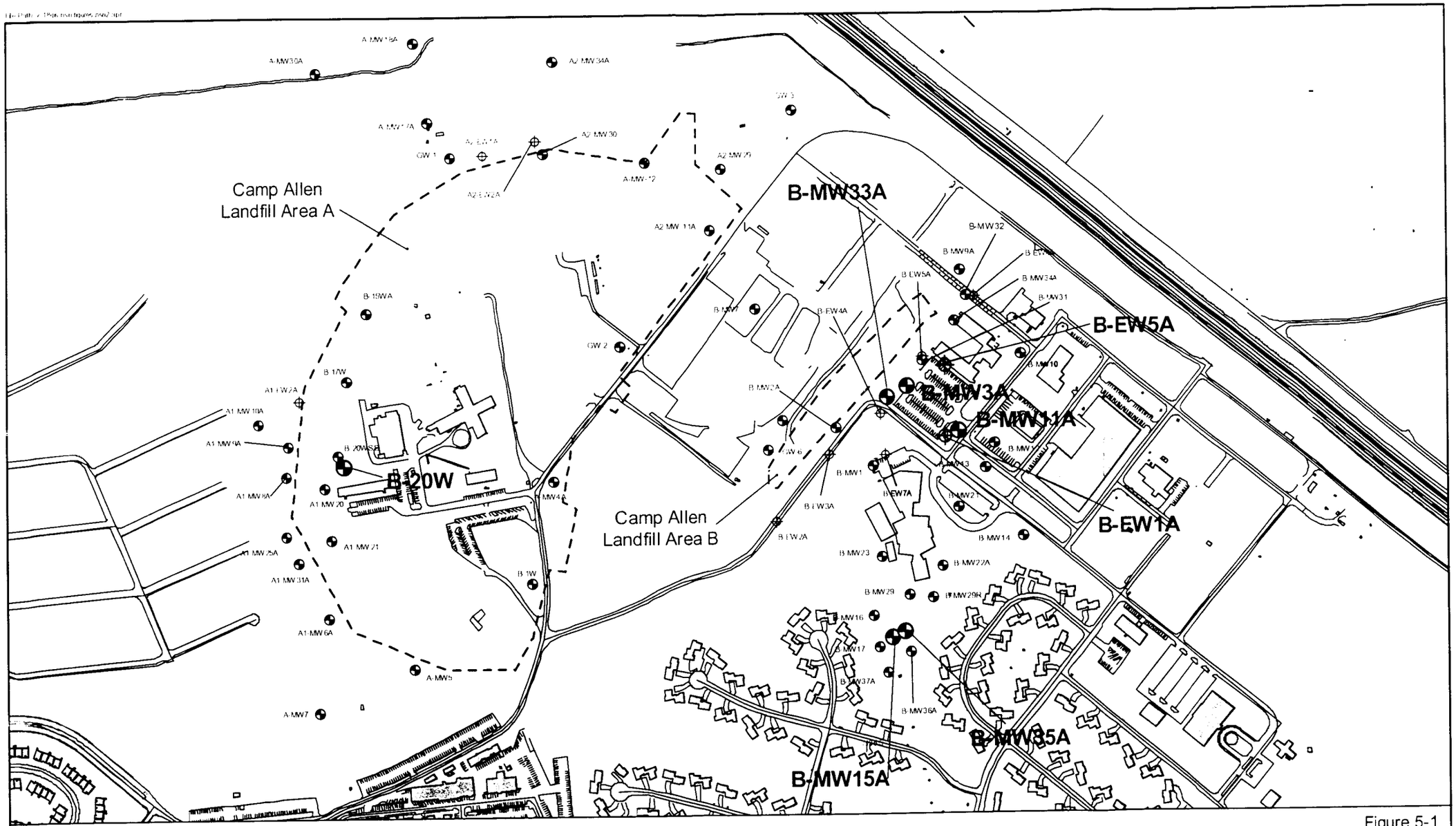
Not applicable at this time.

5.6.5 Changes in ARARs or Other Risk-Related Factors

Not applicable at this time.

5.6.6 Changes in Known Contaminants, Sources, or Pathways at the Site

Not applicable at this time.



LEGEND

- ▲ SURFACE WATER LOCATION
- ◓ SHALLOW MONITORING WELL LOCATION
- ⊕ SHALLOW EXTRACTION WELL
- - - AREA BOUNDARY LINE

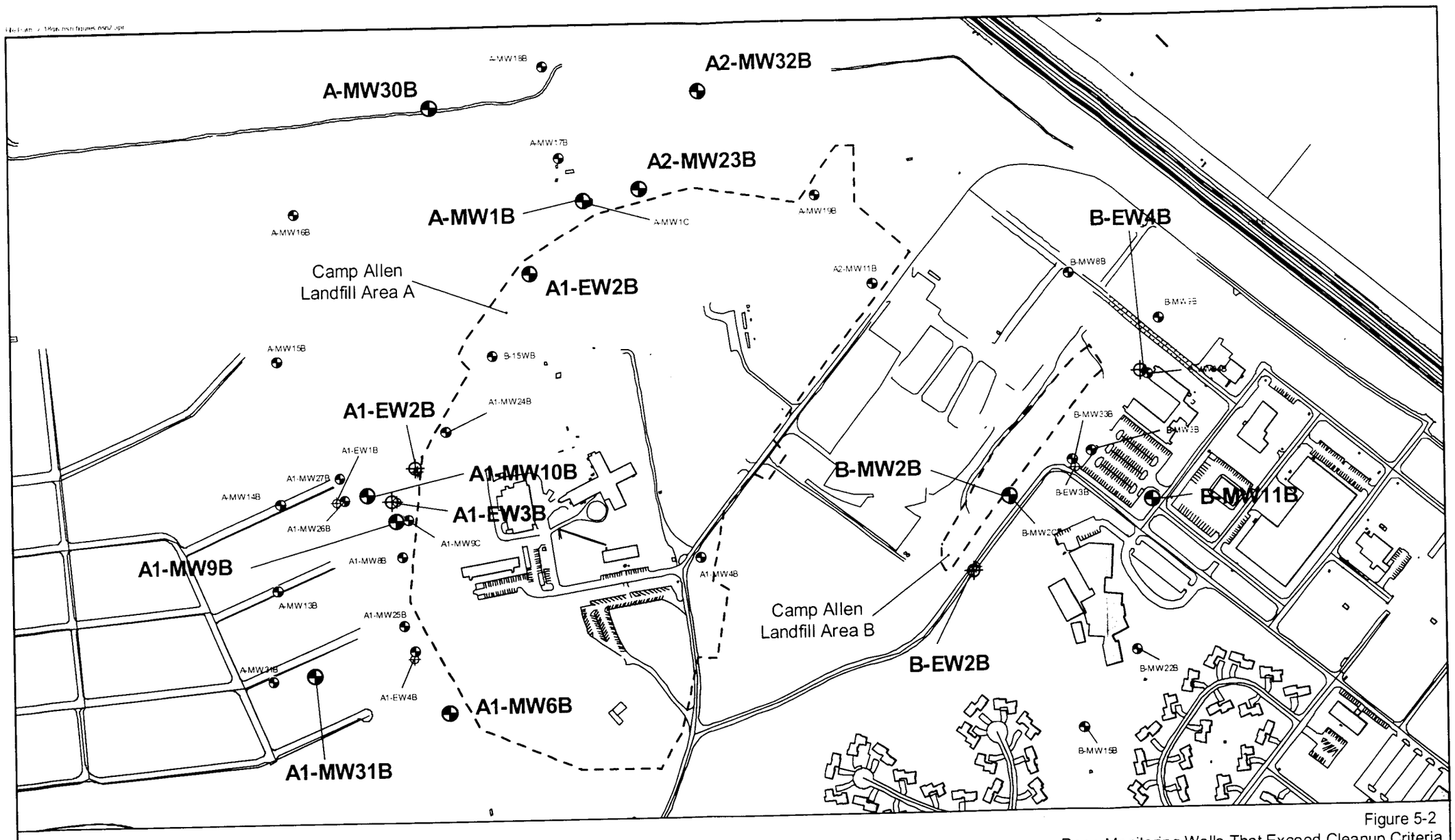
Note:
The labels of the monitoring wells that exceed cleanup criteria are in bold.

N

0 200 400 Feet

Figure 5-1
Shallow Monitoring Wells That Exceed Cleanup Criteria
Areas A and B
Camp Allen Landfill
Long-Term Monitoring Program
Naval Station Norfolk

CH2MHILL



LEGEND

- DEEP MONITORING WELL LOCATION
- DEEP EXTRACTION WELL
- AREA BOUNDARY LINE

Note:
The labels of the monitoring wells that exceed cleanup criteria are in bold.

N

0 200 400 Feet

Figure 5-2
Deep Monitoring Wells That Exceed Cleanup Criteria
Areas A and B
Camp Allen Landfill
Long-Term Monitoring Program
Naval Station Norfolk

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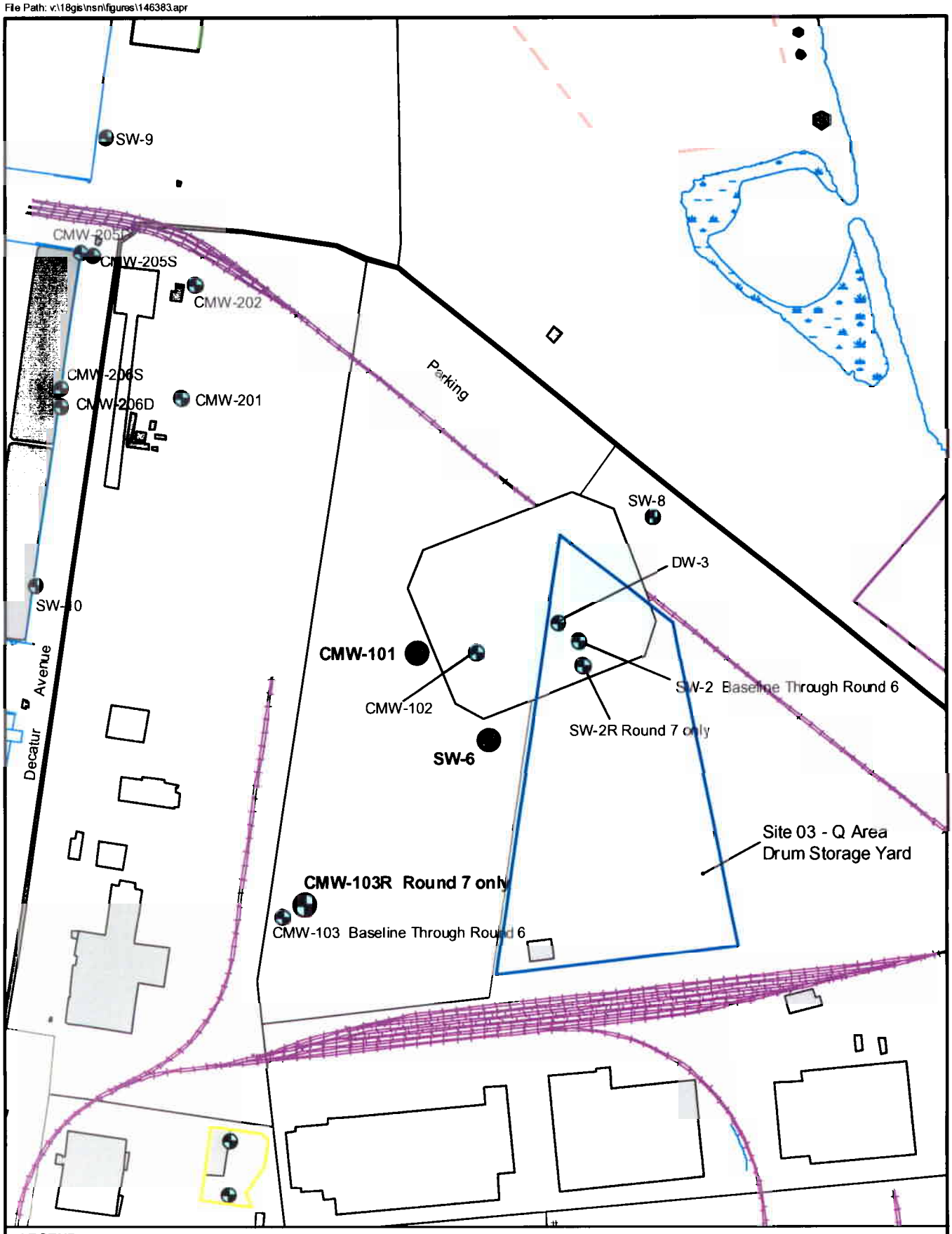

Figure 5-3
Monitoring Wells That Exceed Cleanup Criteria
Q Area Drum Storage Yard - AOC 1
Long-Term Monitoring Program
Naval Station Norfolk

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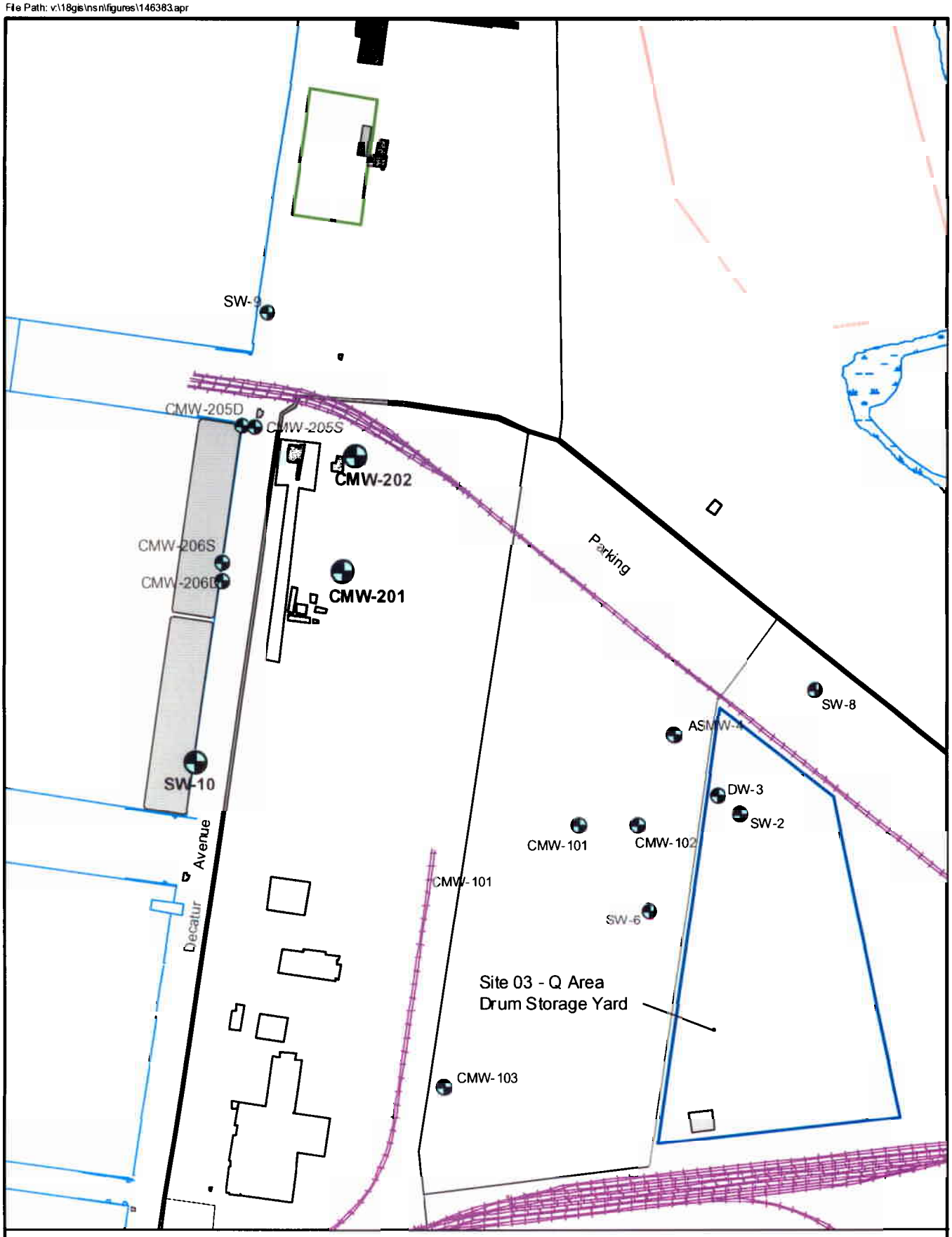

Figure 5-4
Monitoring Wells That Exceed Cleanup Criteria
Q Area Drum Storage Yard - AOC 2
Long-Term Monitoring Program
Naval Station Norfolk

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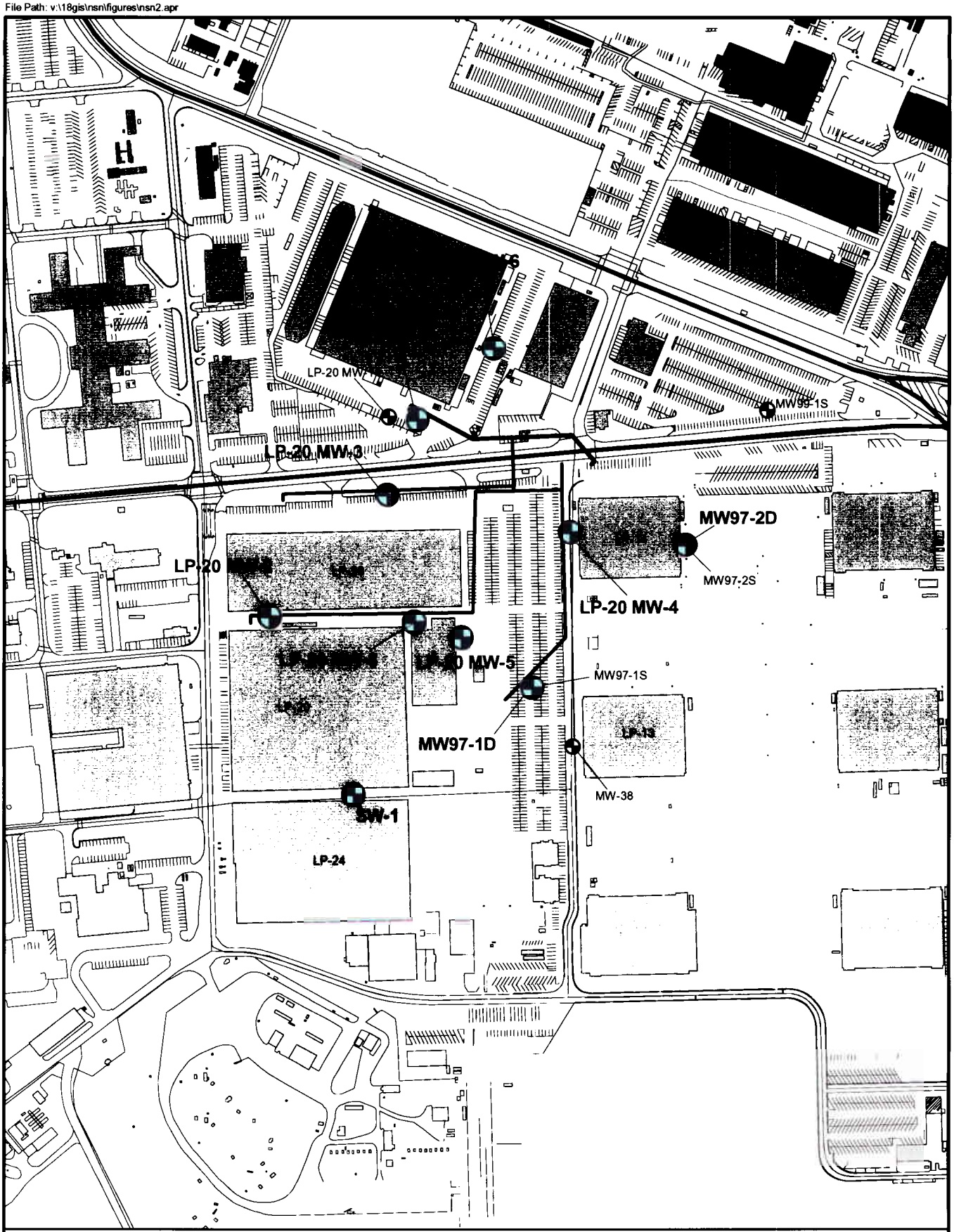

LEGEND

- Monitoring Well
- Approximate Alignments of Air-Spacing and Soil-Vapor Extraction Wells and Piping

Note:
The labels of the monitoring wells that exceed cleanup criteria are in bold.

N

0 300 600 Feet

Figure 5-5
Monitoring Wells That Exceed Cleanup Criteria
LP-20 Site
Long-Term Monitoring Program
Naval Station Norfolk

CH2MHILL

6 Remedy Issues

This section addresses potential issues observed during the site inspections or identified during a review of the analytical data.

6.1 Site 1—Camp Allen Landfill

Based on the review of the groundwater modeling and analytical data by the subgroup, the following issues have been identified:

- A localized area where VOC levels exceed the cleanup goals was observed in the shallow aquifer outside of the capture zone in Area B. The elevated concentrations are observed in monitoring wells B-MW15A and B-MW35A at the southeast of Area B. Although this location is contained by the capture zone of the deep aquifer, it is outside the influence of the shallow extraction wells. Extraction wells are currently being installed to extend the influence of the shallow system.
- A localized area where VOC levels exceed the cleanup goals was observed in the shallow aquifer at well B-20W located proximal to the DPVE system in Area A. Although this location is contained by the capture zone of the deep aquifer, it is outside the influence of the shallow extraction wells. The DPVE system is being evaluated and modified to extend the influence of the shallow system.
- Although the VOC plume in the deep aquifer is effectively contained from migrating towards the residential areas, the northern boundary of the plume has not been captured in Area A. Extraction wells are currently being installed to extend the influence of the deep system.

6.2 Site 2—NM Area Slag Pile

No concerns were identified with the remedy at the NM Area Slag Pile.

6.3 Site 3—Q-Area Drum Storage Yard

The majority of VOC concentrations have been reduced at AOC 1. However, as a result of the VOC degradation, concentrations of vinyl chloride have increased at locations downgradient of AOC 1. The subgroup has recommended a strategy to extend the AS system to the downgradient locations to accelerate the remediation.

In addition, several monitoring wells (SW-10, DW-6, SW-9, and DW-5) at AOC 2 were damaged during recent bulkhead construction activities.

6.4 Site 6—CD Landfill

Several minor maintenance issues were noted during the January 2002 annual inspection of the CD Landfill as detailed in the Technical Memorandum (CH2M HILL, January 2002). The site was revisited on July 29, 2002 per the Five-Year Review requirement. Some of the concerns noted in the January inspection could not be verified in July due to heavy vegetative growth at the site. The issues from both inspections are summarized below:

- A portion of the north sideslope of the northernmost channel is steadily eroding, but the landfill cover system is not in jeopardy as the erosion is on the opposite side from the landfill.
- The fence along the eastern side of Seabee Road adjacent to the southern entrance gate is in need of repair. The poles are bent and the top railing is detached.
- There are eroded areas near the downstream ends of the 60- and 36-inch culverts.
- There is a small denuded patch of ground on the southeastern corner of the landfill.
- A number of the drainage net outlet pipes could not be located during the inspection and are likely covered by sediment.

6.5 Site 20—Building LP-20

The concentrations of VOCs have increased above the cleanup goals in deep monitoring well MW97-2D located approximately 200 feet east of the treatment system. The subgroup is currently evaluating the system to determine options.

6.6 Site 22—Camp Allen Salvage Yard

No concerns were identified with the remedy at the Camp Allen Salvage Yard.

7 Recommendations and Follow-up Actions

This section details recommendations for the deficiencies observed at the sites. Some of these recommendations are being implemented at the time of this report.

7.1 Site 1—Camp Allen Landfill

- The VOC concentrations exceeding the cleanup goals southeast of Area B are currently being addressed by the installation of an additional shallow extraction well in the area.
- Monitoring well B-20W (the location of the VOC exceeding the cleanup goals west of the brig) will be added to the annual LTM sampling. Though the monitoring well is near the existing DPVE system and contained by the extraction system, more localized groundwater remediation of this specific location is recommended. The feasibility of modifying the existing DPVE system to specifically remediate well B-20W is currently under consideration.
- In order to extend the capture zone of the deep aquifer to the northern section of Area A, an additional deep extraction well is currently being installed in the north adjacent to the existing shallow extraction well A2-EW1A.
- The shallow extraction wells in Area B will be evaluated to determine if the pumping rates can be raised to increase the mass removal rates of VOCs in this area.

7.2 Site 2—NM Area Slag Pile

No recommendations were identified for the remedy at the NM Area Slag Pile.

7.3 Site 3—Q Area Drum Storage Yard

The NSN Tier I Partnering Team joint-scoped a strategy in July 2002 to address the remaining vinyl chloride concentrations in AOC 1. The strategy includes extending the existing AS/SVE extraction system at AOC 1 to address this vinyl chloride area. The effectiveness of these alternatives will be evaluated by the subgroup on the basis of success in meeting the cleanup goals. Once the alternative has been implemented, biannual monitoring of the site will continue to track the effectiveness.

The damaged monitoring wells observed at AOC 2 should be repaired during the next drilling event at the Base.

7.4 Site 6—CD Landfill

Proposed repairs for the maintenance issues are as follows:

- The denuded and eroded area noted in Section 6 should be repaired by regrading, seeding, and mulching.
- The fence at CD Landfill is damaged but the integrity is intact and it is not a security issue. Reattaching the top railing to the poles should repair the fenceline.
- The pipes covered by sedimentation may cause a problem if water cannot drain from the drainage net leading to saturated slopes and possible slope failure. It is not currently recommended that the pipes be uncovered as there are other visible drain outlets for water to exit the drainage net. However, the condition of the sideslopes should continue to be monitored and further action may be required if a problem arises.

7.5 Site 20—Building LP-20

The concentrations of VOCs in well MW97-2D should continue to be monitored. If the VOC concentrations continue to increase, localized alternative remedial options should be evaluated.

7.6 Site 22—Camp Allen Salvage Yard

No recommendations were identified for the remedy at the Camp Allen Salvage Yard.

8 Protectiveness Statements

As part of the Five-Year Review for Naval Station Norfolk, a protectiveness statement must be developed for each of the sites.

8.1 Site 1—Camp Allen Landfill

The current operation of the groundwater extraction and treatment at Camp Allen Landfill was found to be protective of human health and the environment. The extraction system has prevented migration of the contaminant plume to residential areas west and southeast of the site. A subgroup has been developed to continually evaluate the remediation system's effectiveness and optimization. As a result of this evaluation, the treatment system is currently being expanded with the addition of new extraction wells to extend the capture zone to contain the plume north of the site.

8.2 Site 2—NM Area Slag Pile

The remedy for Site 2—NM Slag Pile is protective of human health and the environment under the current industrial land use.

8.3 Site 3—Q Area Drum Storage Yard

The current air sparge/soil vapor extraction (AS/SVE) system at the QADSY was found to be protective of human health and the environment. A subgroup has been developed to continually evaluate the effectiveness and optimization of the remediation system at the QADSY. The AS system in AOC 2 is operating and VOC mass continues to be removed from the groundwater at a significant rate. The remediation in AOC 1 has achieved the cleanup goals in those monitoring wells within the radius of influence of the AS system. However, a localized area downgradient of the system has demonstrated increases in the concentrations of VOC breakdown product-vinyl chloride. An enhancement of the remediation system is currently being considered in this localized area. The enhancement of the system is targeted for reduction in the vinyl chloride concentrations to achieve the acceptable levels such that the closeout strategy developed by the NSN Tier I Partnering Team can be achieved.

8.4 Site 6—CD Landfill

The current landfill cap and institutional controls at CD Landfill were found to be protective of human health and the environment. The PWC inspects the CD Landfill quarterly and an outside contractor does so annually. The 2002 annual inspection identified minor maintenance issues including small damage to fence, the erosion of a portion sideslope in drainage channel (opposite side of the landfill), erosion near the downstream ends of the culverts, and potential sedimentation of drainage net outlet pipes. The maintenance issues

will be addressed to prevent potential problems from arising. Even with the minor maintenance issues, the landfill cap and institutional controls remain protective.

In addition, once adequate LTM sampling is conducted, a trend analysis will be conducted to determine constituent migration patterns.

8.5 Site 20—Building LP-20

The current AS/SVE system at Building LP-20 was found to be protective of human health and the environment. The system has been effective in reducing the VOC concentrations within the contaminant plume. Additional evaluation will be completed to determine if the system is operating effectively and if there is potential for optimization.

8.6 Site 22—Camp Allen Salvage Yard

Once completed, the remedy for Site 22—Camp Allen Salvage Yard is anticipated to be protective of human health and the environment under the projected recreational land use.

9 Next Review

The completion of the next Five-Year Review for Naval Station Norfolk is required by November 2007, 5 years from the completion of this review.

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Interview Summary

Personnel Interviewed: **Mark Pisarcik, Superintendent, Shaw E & I, Inc.**

Interviewer: **Ben Francisco/CH2M HILL, Paul Landin/CH2M HILL**

Date: **July 29, 2002**

Location: **Camp Allen Treatment Plant**

Have there been any alterations to the groundwater treatment and extraction system from the original design?
Ferric chloride has been added to the system to precipitate out metals in the groundwater.

1. Is the treatment system functioning as designed?
   The shallow extraction wells in Area A (A2-EW1A and A2-EW2A) are not operating due to the low hydraulic conductivity of the soils. Deep extraction well A1-EW2B was damaged due to collapse of the well casing and is currently not in operation.

Personnel Interviewed: **Mark Pisarcik, Superintendent, Shaw E & I, Inc.**

Interviewer: **Ben Francisco/CH2M HILL, Paul Landin/CH2M HILL**

Date: **July 29, 2002**

Location: **Q-Area**

1. Have there been any alterations to the groundwater treatment and extraction system from the original design?

   The SVE system has been turned off in both AOC 1 and AOC 2 because the vapor readings became too low for practical use of the system. Operations of the AS system in AOC 1 are cycled (2 weeks on, 2 weeks off).

2. Is the treatment system functioning as designed?

   With the exception of the changes noted, the treatment system is functioning as designed.

Personnel Interviewed: **Mark Pisarcik, Superintendent, Shaw E & I, Inc.**

Interviewer: **Ben Francisco/CH2M HILL, Paul Landin/CH2M HILL**

Date: **July 29, 2002**

Location: **LP-20**

1. Have there been any alterations to the groundwater treatment and extraction system from the original design?

   The system in Areas 1 and 2 is cycled 3 weeks on and 1 week off per month.

2. Is the treatment system functioning as designed?

   With the exception of the changes noted, the treatment system is functioning as designed.

Personnel Interviewed:	**Mark Pisarcik, Superintendent, Shaw E & I, Inc.**
Interviewer:	**Ben Francisco/CH2M HILL, Paul Landin/CH2M HILL**
Date:	**August 5, 2002**
Location:	**Camp Allen DPVE System**

1. Have there been any alterations to the groundwater treatment and extraction system from the original design?

   No.

2. Is the treatment system functioning as designed?

   Yes.